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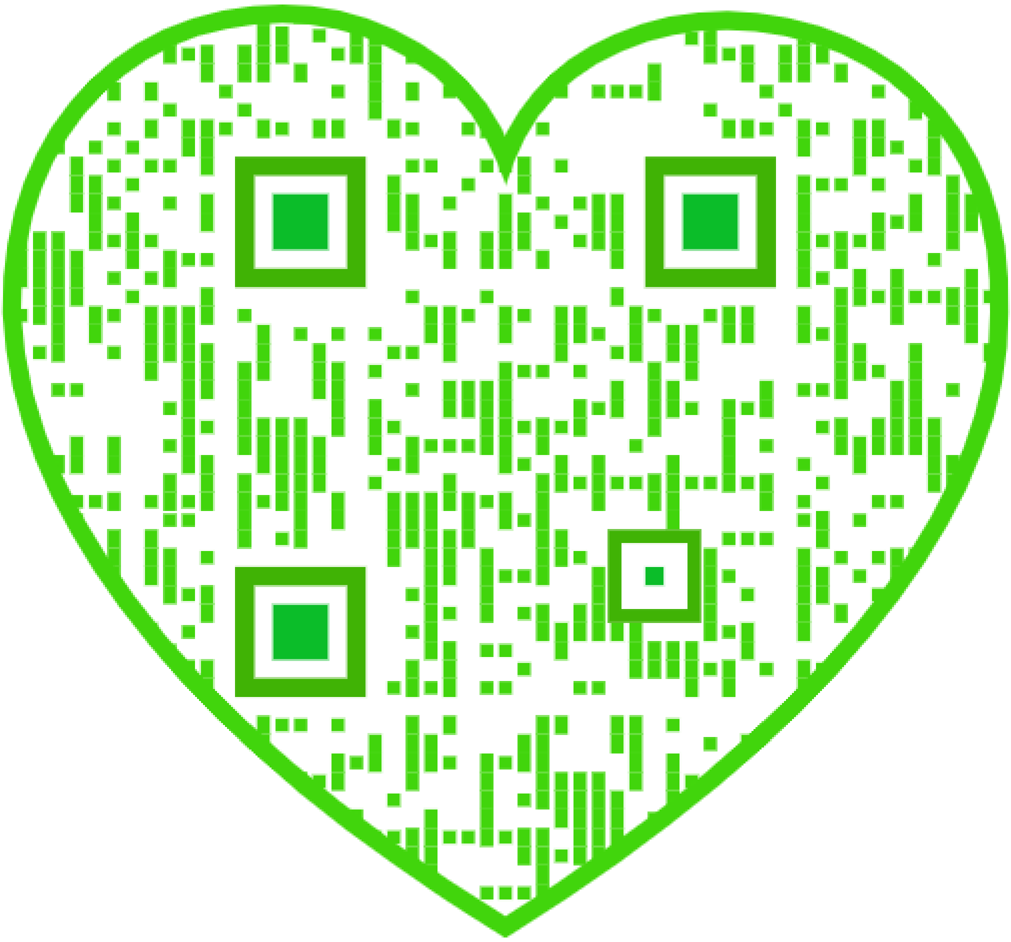

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Welcome

It's been a few weeks that no one could have predicted in terms of Western defence strategy against Russia. For the first time in many decades, it looks as though European nations are finally reassessing their defensive posture, with the focus shifting to relying more on their 'next-door neighbours' than the long-held procedure of expecting the US to charge across the Atlantic in force and be the 'quarterback' if things ever turned hot.

After years of letting their defence budgets whittle down, a flurry of political meetings in recent days has shown a rapid turnaround across Europe, with many countries at last understanding that full US support may not be forthcoming in times of a military crisis. Ex-MI6 chief John Sawers was quoted during an interview with Sky News: "Certainly Europe has been taking advantage of the level of US defence and security support that we have had, especially since the end of the Cold War, and it's quite clear to me we're going to have to step up the capacity of Europe to defend itself."

While many analysts believe the impacts of this approach won't be immediate, the possibility of European nations becoming defence industry powerhouse in terms of weapons development and production has been openly discussed as being achievable in around five years. While for many, there's long been a belief that Europe needs to stand on its own, at the same time, many nations have diverted funds from their defence budgets to other departments with little fanfare. Such tactics have now come back to haunt many governments at a time when they need to project a strong offensive capability if threatened.

For Europe, there's a slow, polite readjustment in how it deals and works with the US. How this will impact the multiple commercial and military aviation defence programmes in the months and years ahead may well be as unpredictable as the last few weeks, but it's safe to say that Europe will in no way be left behind in advancing technology and developments.

Glenn Sands
Editor

TOP:
European nations are already increasing their defence budgets significantly following their unpredictable relationship with the United States
European Union

FRONT COVER:
With manufacturing now back in the UK, Britten-Norman is set to increase production of its sought-after Islander over the next few years
Britten-Norman

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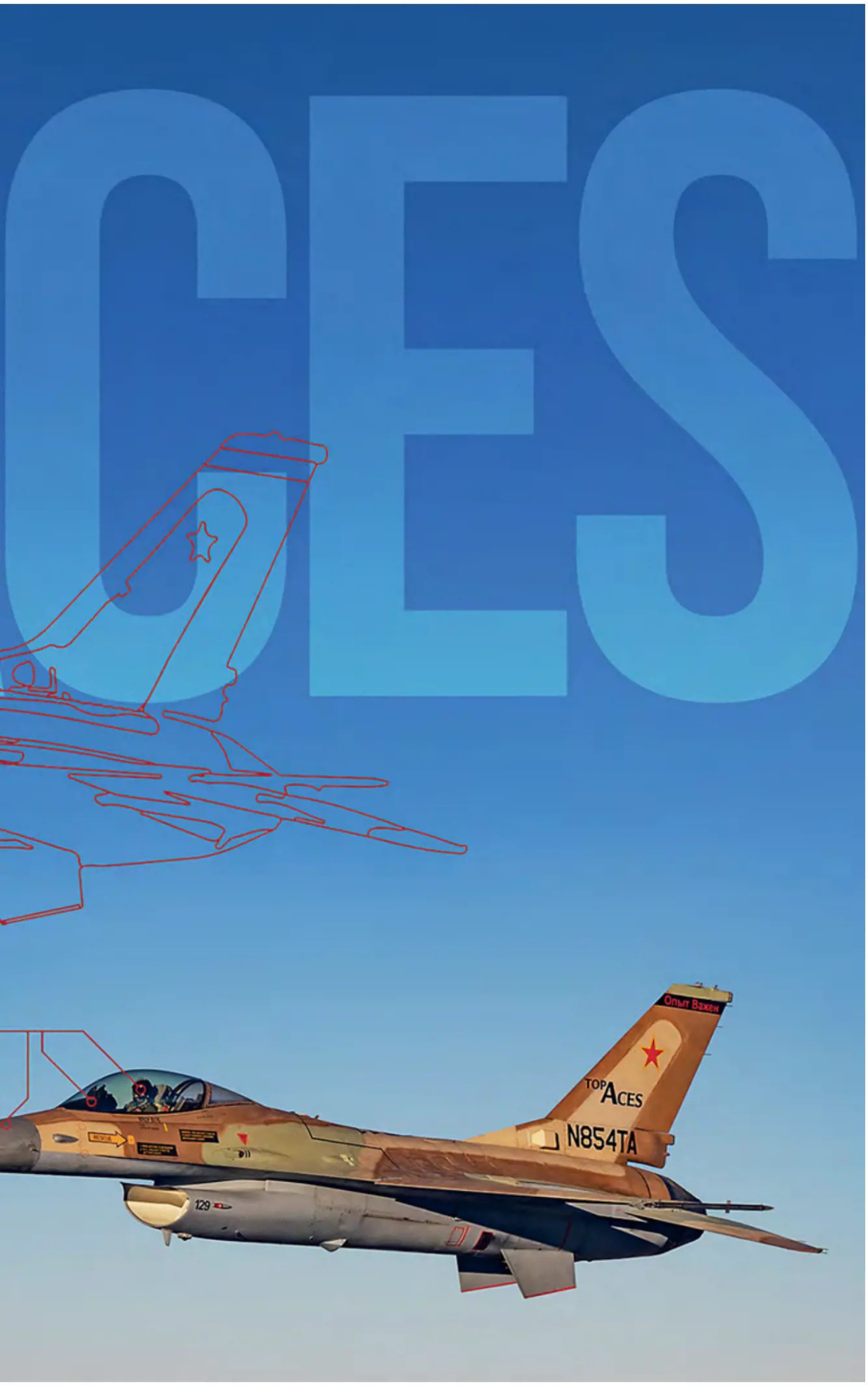
Dueling real and imaginary AI adversaries

The increasing application of artificial intelligence (AI) across the military aerospace sector continues to evolve. While recent focus has been on developing and advancing the capabilities of collaborative combat aircraft (CCA) to fly alongside manned fighters, AI's move into advanced air combat training is now taking place.

Top Aces, a privately owned Canadian company that has been providing adversary air training to the US, Canada, and German armed forces, among its many clients, for more than a decade, announced a significant new development with its adversary air (ADAIR) capabilities that it will be able to offer as part of its air profile portfolio later this year.

In collaboration with technology partners EpiSci, Coherent Technical Services Inc., and Seger Aviation LLC, Top Aces has unveiled an AI-driven autonomous constructive wingman for the Red Air industry. This innovation will mirror adversary aircraft's flight kinematics and manoeuvres in a live-virtual-constructive (LVC) training environment.

Russ Quinn, president of Top Aces and former USAF fighter and aggressor pilot, stated: "The introduction of a constructive wingman marks a revolutionary achievement and sets a new precedent in the ADAIR industry," he added. "Integrating AI-driven constructive wingmen will enhance the effectiveness of our training programmes by adding a complexity and mass challenges to



LEFT: ***Top Aces currently operates a fleet of just four F-16 Advanced Aggressor Fighters (AAF) modified to the AAF configuration, including Link-16 datalink capability needed for aggressor training against fifth-generation F-35s. The company acquired 29 ex-Israeli F16A/Bs from 2021– it is as yet unknown whether further F-16s will be upgraded to the AAF configuration***
Top Aces Inc

Beyond-Visual-Range (BVR) targeting for our customers, while still providing the unique benefits of training against live, highly manoeuvrable, fourth-generation fighters."

The constructive wingman has been integrated into Top Aces' F-16 fleet using the aircraft's open architecture Advanced Aggressor Mission System (AAMS) and is powered by EpiSci's developed AI technology package. The AAMS hands-on-throttle and Stick (HOTAS) interface will allow Top Aces' pilots to direct constructive wingman formations and manoeuvres, co-ordinating them with the company's F-16s to provide additional BVR targeting challenges for fifth-generation fighter pilots flying F-35s during air-adversary exercises. Each wingman is embodied in the air training exercise as an adversary Link-16 track, increasing the number of BVR adversaries to enhance 'combat' engagement scenario segments at a reduced cost. Simply put, Top Aces pilots will be able to add a 'virtual' aggressor aircraft through their electronic suite in their cockpit to the radar and sensor images that both opposing pilots will be able to see during a training scenario. Although no additional aggressor aircraft is present in the air, the sensor displays presented to the pilots 'in the fight' will combine real and synthetic targets.

"Having flown every fourth- and fifth-generation fighter, classified prototypes and demonstrators, I know firsthand the challenges and opportunities AI brings to air combat," said Dan Javorsek, president of EpiSci. "This is the future of air combat training. Integrating AI-driven wingmen will push the limits of training while preserving the value of live-fly fourth-generation adversaries."

Speaking to The War Zone, Top Aces' director of enterprise technology, Aaron "Fang" Steffens, believes the mix of tracks in the air will ratchet up the psychological pressure for those pilots under training, adding: "There are so many things you can and want to do in a virtual training environment right now, especially high-end tactics. But we don't think there's a replacement for live training with real airplanes out there. It changes the dynamic of how the student, or even an experienced instructor, is thinking when moving at speed. There are other live aircraft out there that are trying to shoot you, and there's an element of risk."

Following the completion of operational testing and evaluation, Top Aces plans to expand its constructive wingman concept, introducing additional constructive training capabilities to its customers. One of these will be the Royal Netherlands Air Force, which awarded a framework agreement to AEC Skyline and Top Aces for ADAIR training services across its Air Combat, Air Mobility, and Defence Helicopter Commands as a proof-of-concept scheme.

The control, autonomy and interface developments from this innovation will lay the foundations for the deployment of future unmanned collaborative adversary platforms as part of an overall technology upgrade towards all ADAIR training in the future. This development may well see aggressor training involving mixed formations of manned and unmanned platforms opposing future USAF pilots in training. Top Aces is determined to contribute and be involved in this emerging development sector. **AI**

With a demonstrated range of 336nm and a maximum cruise speed of 135kts, the ALIA CX300 CTOL will operate between traditional airports, utilising their runways during the test demonstration flights at an estimated cost of US$28 per flight hour
Bristow Group Inc

No aviation emissions in **Norway**

On March 4, 2025, the first formal agreement to establish Norway as an international arena for zero and low-emission demonstration aviation flight tests was signed at Bergen Airport, Fiesland, with American aircraft manufacturer BETA Technologies and Bristow Norway AS. This first agreement is a result of a prior 2024 collaboration between Avinor and Norway's Civil Aviation Authority (CAA), which is keen to increase Norway's presence within this emerging technology.

Avinor is a state-owned limited company with the Norwegian Ministry of Transport and Communications and is responsible for 44 state-owned airports. To date, the company has taken a leading role in the development of electric aircraft, reducing gas emissions from the aviation industry and supplying sustainable aviation fuel (SAF). Norway's CAA has long been focussed on sustainable aviation and views the collaborative agreement, which will include EASA to assist in contributing to regulatory agreement oversights and learning. Including such regulatory bodies will allow safe testing and a "phased approach of new technologies into the ecosystem", according to the CAA. Such a method will enable regulators to identify where regulatory changes are required and ensure that approval and certification processes are prepared and carried out efficiently with the assistance and input from CAA Norway's main office located in northern Norway at BodØ.

BETA Technologies is an electric aerospace company that has developed the single-pilot capable ALIA CX300 conventional take-off and landing (eCTOL), the platform used on demonstration flights. The aircraft, BETA's second production vehicle, was manufactured at the company's scaled production factory in Vermont, USA, and has already received airworthiness certification for VFR, IFR, day and night flying from the FAA. It is due to arrive in Norway later this year. The demonstration flights will be cargo-focused without passengers and flown by Bristow Norway. These early cargo flights will operate initially between Stavanger and Bergen Airports, starting from the former in late summer, with the entire route planned to take place in late 2025.

Executive VP and Chief Transformation Officer for Bristow Group, Dave Stepanek, stated: "This regulatory sandbox evaluation project exemplifies our philosophy of crawl, walk, run for early adoption of new aviation technologies and solidifies the commitment to our vision to be a leader in innovative and sustainable aviation," he added. "Bristow Norway is proud and honoured to partner with this distinguished group of leaders in advanced air mobility." Adding to the high anticipation for this new development agreement, Patrick Buckles, BETA's Sales Lead, stated: "We see great value in real-world demonstrations, both to understand performance and mission offers, but also to bring the local communities in what this technology offers," he continued, "This year, we operationalise this technology, we're excited to showcase how its low-cost, high-reliability operations can serve markets all over the world, including Norway." **AI**

The revised futuristic looks of the all-electric Alice are the result of a recent CoDR, but for the time being, the prototype aircraft has yet to make a second flight Both images via Eviation

Eviation downsizes and halts work on Alice

Electric aircraft developer Eviation has announced mass redundancies across the company and halted work on its Alice all-electric jet. Although exact numbers have not been released, it is believed that most of the 30-strong workforce has been laid off. In an official statement, CEO Andre Stein said: "This decision was not made lightly. However, we believe this temporary pause is a necessary step to focus on identifying the right long-term partnerships to help us make the electric commercial, regional flight a reality."

The drive for more eco-friendly electric commercial aircraft has showed no signs of slowing in recent years, with several manufacturers having proposed and exhibited full-scale mock-ups or even test-flown examples. However, much like the eVTOL market, cracks are now appearing within the sector, as some OEMs are struggling to acquire funding and investors to continue progressing with their development.

The Alice, designed to carry nine people or 2,500lb of cargo across a range of 290 miles, has attracted significant interest, resulting in orders for the aircraft totalling more than 600. According to the company, the orders are worth around $5bn and include leading clients such as Air New Zealand, GlobalX, and DHS Express (see *Air International*, November 2024). The most recent order announced was in October 2024, with UrbanLink Air Mobility, for up to 20 of the commuter aircraft.

Andre Stein, CEO of Eviation, has announced a pause in the development of Alice

The Alice prototype has completed only one eight-minute flight in September 2022. The company says it has since remained on the ground, undergoing minor design tweaks. According to Eviation's website, the aircraft underwent a significant conceptual design review (CoDR) during its development, the most recent of which was completed in April 2024. The company had previously stated that it intended to begin deliveries of the Alice from mid-2027, but given recent events this now appears unlikely while the company assesses its next move.

Stein has insisted the Alice programme will not be fully shut down, but has not elaborated on its future, simply stating: "It's time to explore strategic opportunities." **AI**

Microliner macro market

For VÆRIDION to offer the most energy-saving way of flying, the company took inspiration from gliders in the design of the Microliner All images via VÆRIDION unless stated

VÆRIDION, a new airframer, aims to offer cost-effective electric flying beyond niche markets with its nine-seat Microliner, as reported by

Bernie Baldwin

seeks

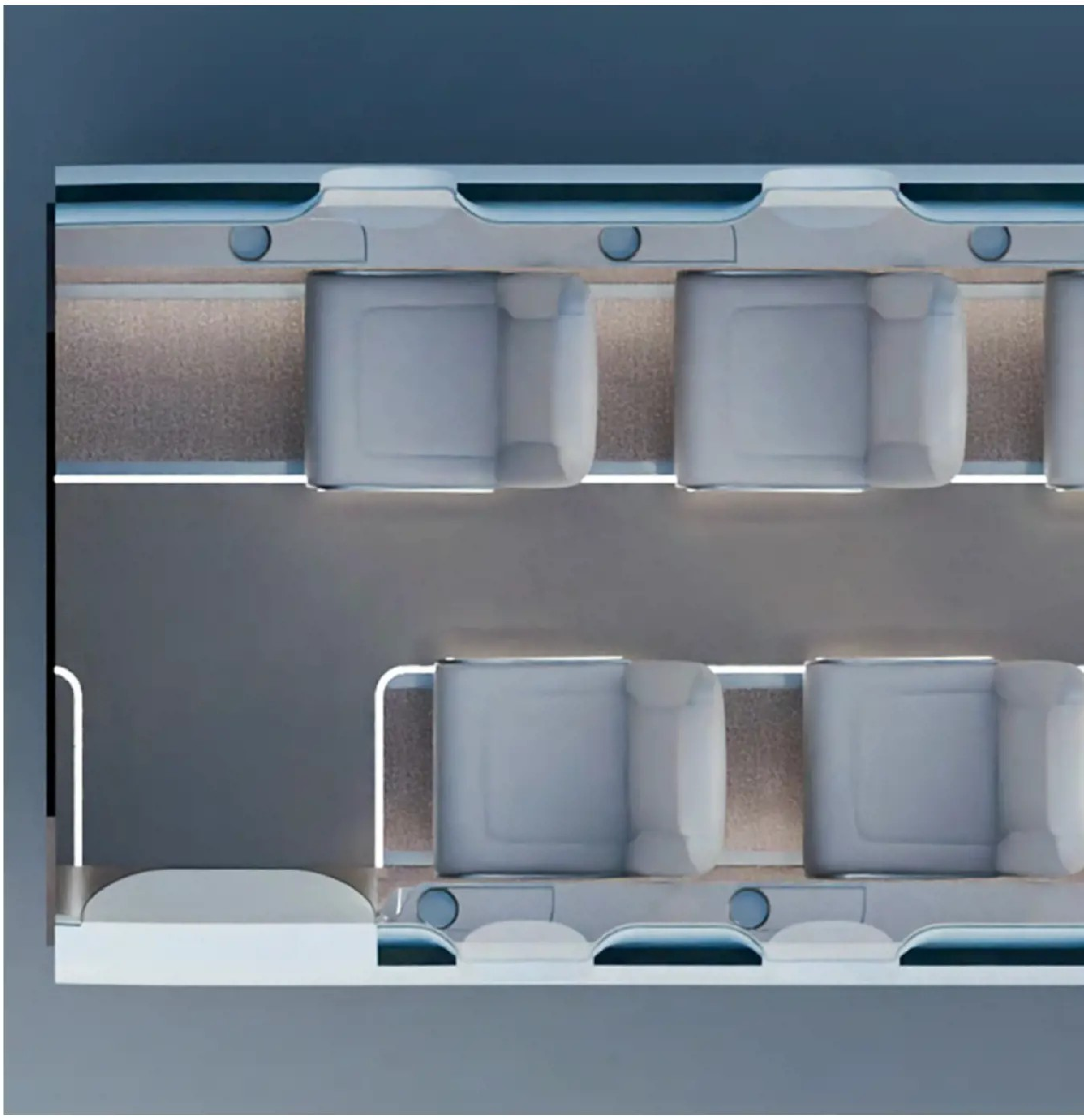
“It’s physics, regulations, and a business case!” says Ivor van Dartel, co-founder and CEO, outlining several reasons for his company, VÆRIDION, to choose a nine-seat configuration for its planned all-electric Microliner aircraft.

“Let’s start with physics. Electric flight has constraints, the biggest of which right now is the state of battery technology, specifically the energy density of the chemistry inside,” van Dartel elaborates. “If you do the maths, you will find that to do a meaningful range, the current physical limit is around six metric tonnes take-off mass for a pure battery electric aircraft. That puts the aircraft in the CS23 category, which has a threshold of nine seats. The next one is 19 seats and if you flip from nine to 19, the certification effort can jump by an order of magnitude.

“If you have a 19-seat aircraft, you must demonstrate a probability of ten to the minus nine (10–9) of a catastrophic failure. At nine seats, you have to demonstrate ten to the minus eight (10–8), so one in a hundred million versus one in a billion probability that something really bad happens. That doesn’t mean that the nine-seater is ten times less safe; it means the effort required to demonstrate that is ten times less,” he indicates.

“Finally, on the business case side, there are different ways to describe it – from very conservative towards very visionary. If we stay with the most conservative case where we could only replace existing aircraft, the nine-seat market is alive with about 500 deliveries per year and about 15,000 aircraft in service. We also found out that our seat-mile cost of the electric nine-seater will allow it to compete with 19-seat and maybe even 50-seat aircraft. So, we

effect



ABOVE:
Ivor van Dartel, co-founder and CEO of VÆRIDION

RIGHT:
Up to nine passengers plus crew can travel up to 500km in the electric Microliner

could chip into those markets as well. In a nutshell, these three drivers led us to the nine-seat size," van Dartel states.

Alongside entering higher capacity markets and undertaking certain routes there, the Microliner should also facilitate increased frequency due to the length of the routes. "The operational mission is, first and foremost, commercial flights – both scheduled and chartered," the CEO emphasises. "Typically, you find nine-seat aircraft in charter markets and significantly fewer in the scheduled sector. However, as our seat-mile costs are considerably lower, we perceive a substantial opportunity in the scheduled sector, particularly on thinner routes."

Van Dartel chooses an intriguing example to illustrate the Microliner's scheduled service and its short route potential. "Let's consider London-Paris. It's clear that you won't substitute the 20 to 30 daily flights with A320s from Heathrow to Charles de Gaulle, but you could possibly fly from Biggin Hill to Le Bourget or Toussus le Noble [the name for Paris-Saclay-Versailles Airport until February 2024]. What you provide is the advantage of avoiding queues with other passengers, yet you're not paying for a private flight fare either – something perhaps in between," he remarks.

Taco Stouten, VÆRIDION's VP of Commercial, views the "far Nordics" as a region where 40-seater aircraft can be substituted with nine-seaters. "If you consider companies like SAS or Widerøe, which operate many PSO [public service obligation] routes, they essentially use the aircraft at their disposal like a bus. They travel from one city to another, and everyone who has purchased a ticket can simply hop on or hop off, although in most cases these planes are less than 50% full," he remarks. "On certain flights, there might be only two or three individuals on board. Therefore, the machinery [MHIRJ Dash 8-100/200s] used for those missions is oversized or over-engineered. These airlines continue to use them because they have no other option."

"There's significant potential to replace aircraft that are oversized for the mission by presenting an alternative in the market that makes economic sense," the VP continues. "That's the essence of this technology; because electric flying is so efficient, costs are set to be substantially reduced. Even if you were to fill the 40-seater, the costs of flying the nine passengers on our Microliner would likely be comparable today and lower in the future. That's the value proposition we have on the table, which the airlines we're conversing with are validating."

The Microliner will be powered by two electric engines driving a single propeller, a configuration rarely used in fixed-wing aircraft. "Physics experts realised long ago that it is very efficient to have a single propeller, but one would prefer the redundancy of two engines in the system," comments van Dartel. "Now, for the first time, it is actually practical to implement this, as electric drives are mechanically much simpler compared to large turbines or piston engines."

"First, why did we do it? There's a regulatory reason again. In Europe, to fly commercial, you need to have a twin-engine at least. That's simply the regulation," he says. "There is an exception with the single-engine turbine rule, but you have to have statistics that show that it's so reliable based on engine hours run that we can never meet in the short term. So, we needed to be twin-engined to support the business case.

"What we technically do is have two electric drives on a shaft, but they are not directly coupled; instead, they connect through a freewheeling clutch. Similar to a bicycle, you can only transmit motion in one rotational direction. This means that if one engine fails or jams, it would not impede the shaft itself," the CEO adds. "Hence, two mechanically and electrically segregated engines are running one propeller.

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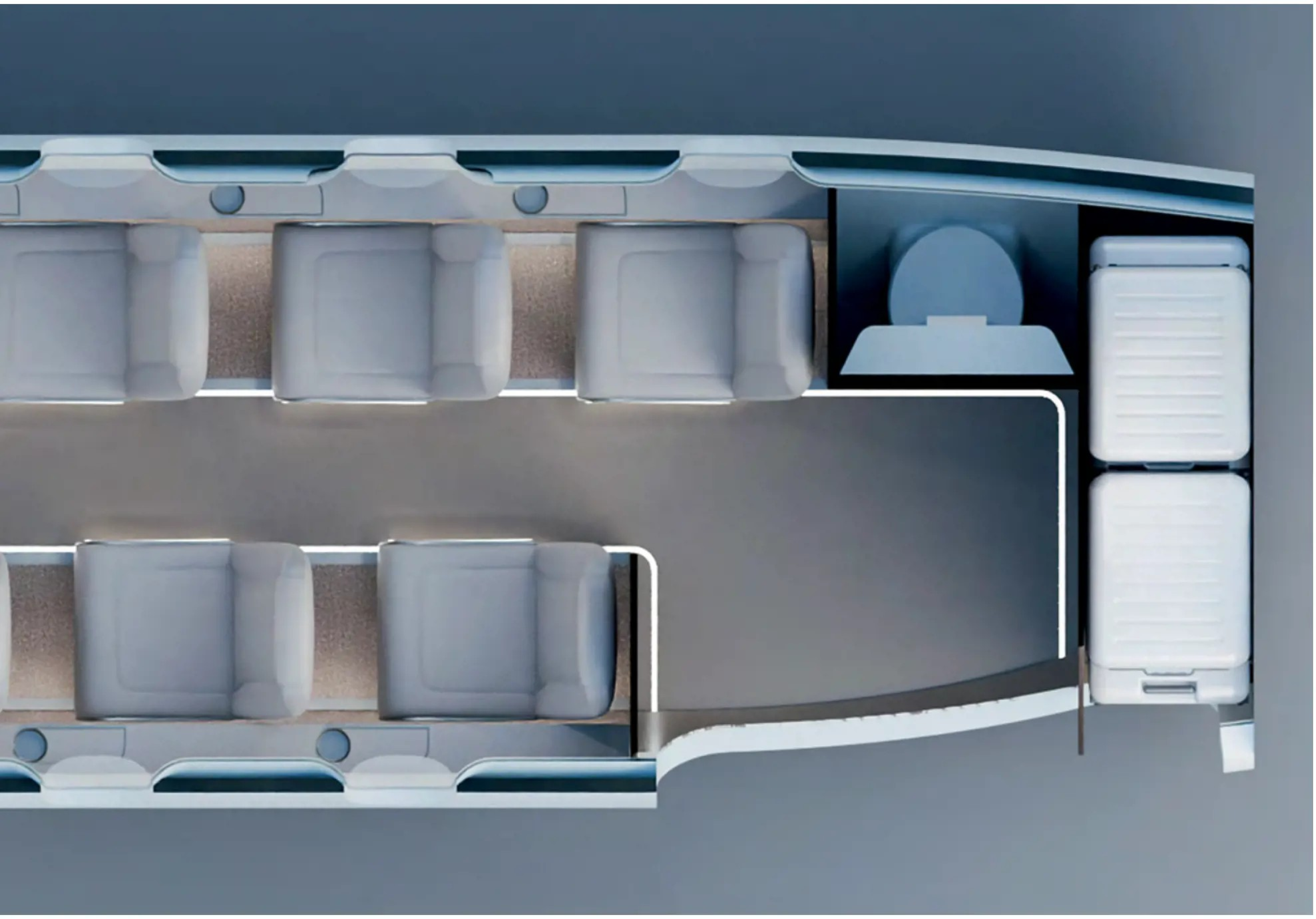

CLOCKWISE FROM RIGHT:

The Microliner cabin is designed for the regular business air traveller

VÆRIDION attended the European Regional Airlines Association's general assembly in 2024, where there was significant interest in the potential of the Microliner within the regional airline sector
Bernie Baldwin

VÆRIDION combines engineering excellence with the latest technology to develop the Microliner

Inside the cabin

The Microliner's interior is designed for frequent travellers. VÆRIDION states that its cabin offers "a generous 32in pitch and 18.3in seat width, even with the nine-seat layout, providing uncompromised legroom and comfort".

In consideration of the busy traveller, the Microliner will offer USB charging points, and internet access may also be available. "Connectivity will largely depend on the airline (customer), but there are plans to implement all the necessary installations," the company states.

This is not common, so we established a pre-application contract with EASA, the regulator, to demonstrate that they are mechanically and electrically decoupled and that, in principle, we enhance safety.

"This is because if you have a one-engine-inoperative situation today, on a classical twin, it increases the workload and the handling for the pilot. If you lose 50% of the power, you might lose 80% of the thrust because you are yawing," van Dartel explains. "In our case you lose only 40% of the thrust because the propeller can run more efficiently on the one engine, and you have no handling differences. So, the pilot's workload shift is very small when one engine is in operative."

Stouten describes the concept as "blind to one another" in that each engine is in no direct contact with the other. However, both transmit torque to the shaft.

Creating a new aircraft of any size nowadays is expensive. Like its larger contemporaries, VÆRIDION has built a coterie of partners, including Saluqi Motors, Dassault Systèmes, GKN Aerospace, and operators such as ASL Group, Copenhagen AirTaxi, ASL Group, and Aero-Dienst.

Van Dartel outlines some key contributions these companies made to the project: "With Dassault Système, we have opted for their software framework, which is called 3D Experience, and includes classical CAD software. More importantly, it includes product lifecycle management software which, if you design an aircraft – and especially when you start building one – must deliver very precise traceability configuration management," he says. "Dassault's landscape allows you to have all the design data. There's no ambiguity in the collaborative framework; it's all in the cloud and managed through databases, so you have very good control of the configuration.

"We have a particularly special deal with them. I cannot disclose the specifics, but let's just say it was very intriguing for us to partner with them from a commercial perspective. We were already convinced of it being a world-class package, but they were also keen to be part of the programme," van Dartel adds.

GKN Aerospace is mainly contributing on two packages. One is the high voltage electrical wiring and interconnect system, where the company is a tier one supplier, as it is for wing structures. VÆRIDION collaborates with GKN on lightweight aerostructures. "In the long run, they could also supply parts for us. GKN doesn't develop aircraft; they develop flying parts for several airframes," the CEO states.

"There are also several partners and suppliers not yet disclosed, but this year, we're trying to pick and choose all the main partners that one would need for such a programme to get an industrial system started," van Dartel adds. "We've selected an engine partner, too, but we haven't disclosed it yet."

Once every partner and supplier is in place, efforts will turn to manufacturing and production. Van Dartel and Stouten experienced the challenge of working in the same factory at Airbus and have contributed to building aircraft. "What we're going for is a light final assembly process that would allow us, should a customer in a certain region order a significant number of aircraft, to assemble them close to the customer. But then a lot of the manufacturing steps will be at the pre-final assembly line level, so maybe you will have an equipped wing or an equipped fuselage coming in and a fairly large portion of these bits will be manufactured at our suppliers. Most of these parts will be fairly standard. The bits that are specific are the battery modules that we will manufacture in-house," he elaborates.

"We have our facility located south of Munich, where we are already

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VÆRIDION

ABOVE: *VÆRIDION is the first e-aviation company to have secured a milestone Pre-Application Contract with the EASA*

RIGHT: *The Munich-based aircraft manufacturer intends to have the zero-emission electric Microliner available to deliver affordable regional flights in Europe by 2030*

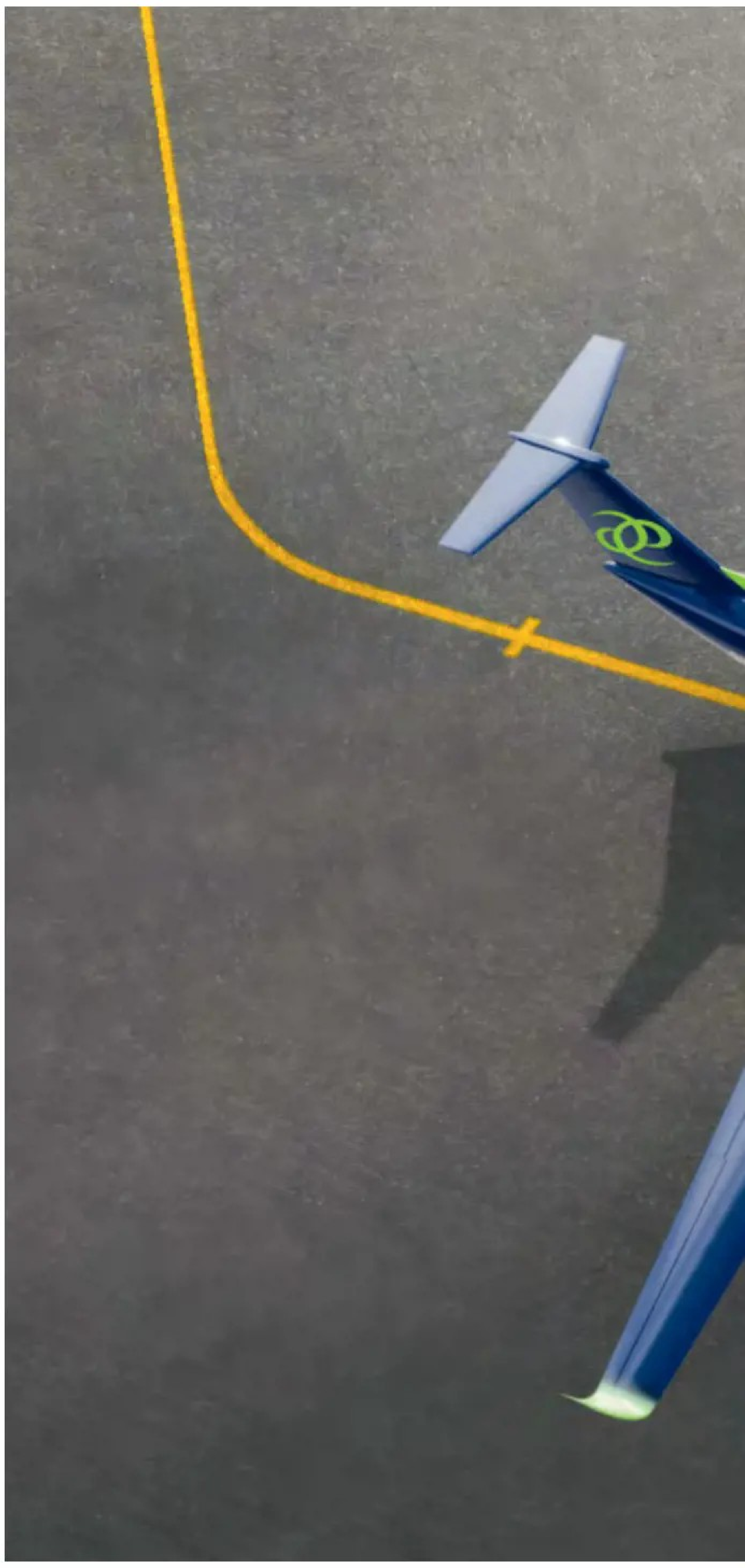
constructing the first prototypes and exploring the automation of battery module manufacturing. Naturally, the wing is quite significant, as the integration of the modules with the wing is one of our key design features that enhances the aircraft's efficiency."

Assembling the wing in-house is crucial, as this is where VÆRIDION will install the batteries to create more space in the fuselage and to help balance the flexing of the wing. "Exactly," declares Stouten. "It's for the same reason that modern aircraft store fuel in the wing, to counteract the bending moment."

The current location for the battery facility is Holzkirchen. "Obviously, once we have the final assembly line, it will need to be near a runway. Oberpfaffenhofen, where Dornier aircraft have been manufactured over the years, is one of those locations in the Munich area, but not the only one. Thus, we have not yet made a final decision on where to build the first aircraft – but it will certainly be in the Munich area," the VP confirms.

The Microliner won't be the only all-electric nine-seater on the market. It will compete with the Eviation Alice (see *Air International*, November 2024) and, most likely, an electric-powered Cessna Caravan, which has already been tested. The VÆRIDION team is ready for the challenges.

"The biggest difference is the efficiency of the aircraft. Because this aircraft has been designed to be electric from the ground up, it will get you the performance



you can get out of an electric aircraft. Aircraft that have been re-engined to become electrical are not getting the efficiency that you need to get the range, to get the required performance," van Dartel explains.

Stouten points out that the Alice aircraft is heavier than the Microliner. "Because of that, it will be more than 5.7 tonnes so it will fall into a higher certification category, one that requires almost the same level of demonstration of safety that you need to comply with for a CS25 standard. The effort to certify that is therefore ten times higher than for our aircraft. The consequence of that is that the list price to the market is likely to be affected. It will at least affect the budget needed to get it realised."

An Alice prototype has also flown, but Stouten is quick to note that the V-tailed aircraft which took to the air has already undergone considerable redesign: "Returning to the Microliner, the placement of the batteries is crucial. From the very beginning, we decided we are not smarter than all the aircraft pioneers before us. If you have something heavy, you place it in the wing. We are very much convinced of our concept."

That comment leads to whether the market reaction is as convincing and how the response has been so far, both numerically and geographically. The latter is important, given the earlier comment that if there was a part of the world where significant orders are garnered, then VÆRIDION may consider assembly nearer to the customer.

The company has certainly been introducing itself to the market. In October 2024, it exhibited at the General Assembly of the European Regions Airline Association (ERA) with a cabin mock-up, the first seen at the event in many years (see *Air International*, December 2024). Van Dartel acknowledges the value gained from that. "We had the opportunity to present to the whole board of the ERA, which mainly consists of airlines' CEOs. The reception of the aircraft was very positive and was seen as a very credible proposition. Much will depend on the readiness of the airline to start taking on aircraft like this into their portfolio. And that depends on the business model that the airline has," he states.

There is confidence that the first binding order will be signed this year in the form of a pre-delivery payment (PDP) schedule. This is likely to be from airlines flying smaller aircraft like Cessna Caravans with up to 50 seats to connect people and regions. Van Datel says: "I cannot disclose any names, but what individuals should consider are the boundary conditions under which certain airlines operate and the type of ecosystem they navigate. Furthermore, it is important to assess whether this aircraft fits into their current business model."

"Launching a brand-new airline and venturing into areas not currently explored will represent another significant step. We anticipate that such an operation will emerge in the market, but initially, the focus will be on tasks that airlines are already performing," van Dartel continues. "Consider all those currently operating smaller aircraft to connect individuals and regions with capacities of up to 50 seats, as we've discussed, including those flying Cessna Caravans, for instance. Most of these aircraft are not utilised to their full potential in terms of distance. They are capable of flying over 2,000km, yet they are not employed for such ranges due to their slower speeds."

Stouten mentions that some operators have already signed up for what VÆRIDION calls "a cooperation agreement", and several partnerships

➔

ABOVE:
The Microliner's high aspect ratio wing provides minimum cruise drag and a high glide ratio

are already public knowledge. We have Copenhagen Helicopter and Air Taxi. They are based out of Roskilde Airport and would like to start connecting different airports within Denmark because of the geographic situation," he reports.

"Another very interesting partner is ADAC, the German air ambulance service that repatriates individuals involved in accidents. They have a green agenda and are keen to start flying with an aircraft like ours. Those are the types of partnerships we have already established, but we are also in close discussions with two operators who wish to utilise our aircraft," remarks Stouten.

Airlines and carriers worldwide that operate services akin to the PSO (Public Service Obligation) routes in Europe and the EAS (Essential Air Service) routes in the United States are clear targets for VÆRIDION. Additionally, operators with a business model similar to that of Cape Air – which has aircraft of a comparable size in its fleet – are also within the company's sights. Furthermore, as noted, there are established airlines that do not currently operate nine-seater aircraft but are eager to introduce a new type and explore new routes to support major carriers.

"To provide a more relatable example, a typical case would be Loganair, which connects various locations across the UK. We've had conversations with them and, indeed, we are also in discussions with Cape Air. It is quite clear who ranks highest on our list for negotiations," admits van Dartel. "From this, we anticipate that if we capture the interest of these individuals, it is likely that we will also attract the attention of those who are more innovative, those eager to establish networks that currently do not exist."

"We need to start somewhere, so our strategy is to roll out first in Europe because we think that the boundary conditions are the most suitable there," he emphasises.

If Microliner achieves the success the team desires by entering various markets, VÆRIDION will gain considerable knowledge from the experience. Therefore, it is likely that the market will be seeking a larger aircraft in five to ten years. Noting that battery capabilities will almost certainly improve in the meantime, van Dartel acknowledges that a larger aircraft with lighter batteries should not be overlooked.

"We will see in the 2030s the possibility of doing a 19-seater, technically speaking. Obviously, the market needs to want it, but I think that by 2040, we would see a CS25 aircraft being feasible. I don't know if it will be 40 or 50 seats, but something in that ballpark will become feasible," he says, stressing: "It's not an aspect we're dedicating much time to at the moment. We're focused on getting the nine-seater out the door, but the technology is certainly scalable."**AI**

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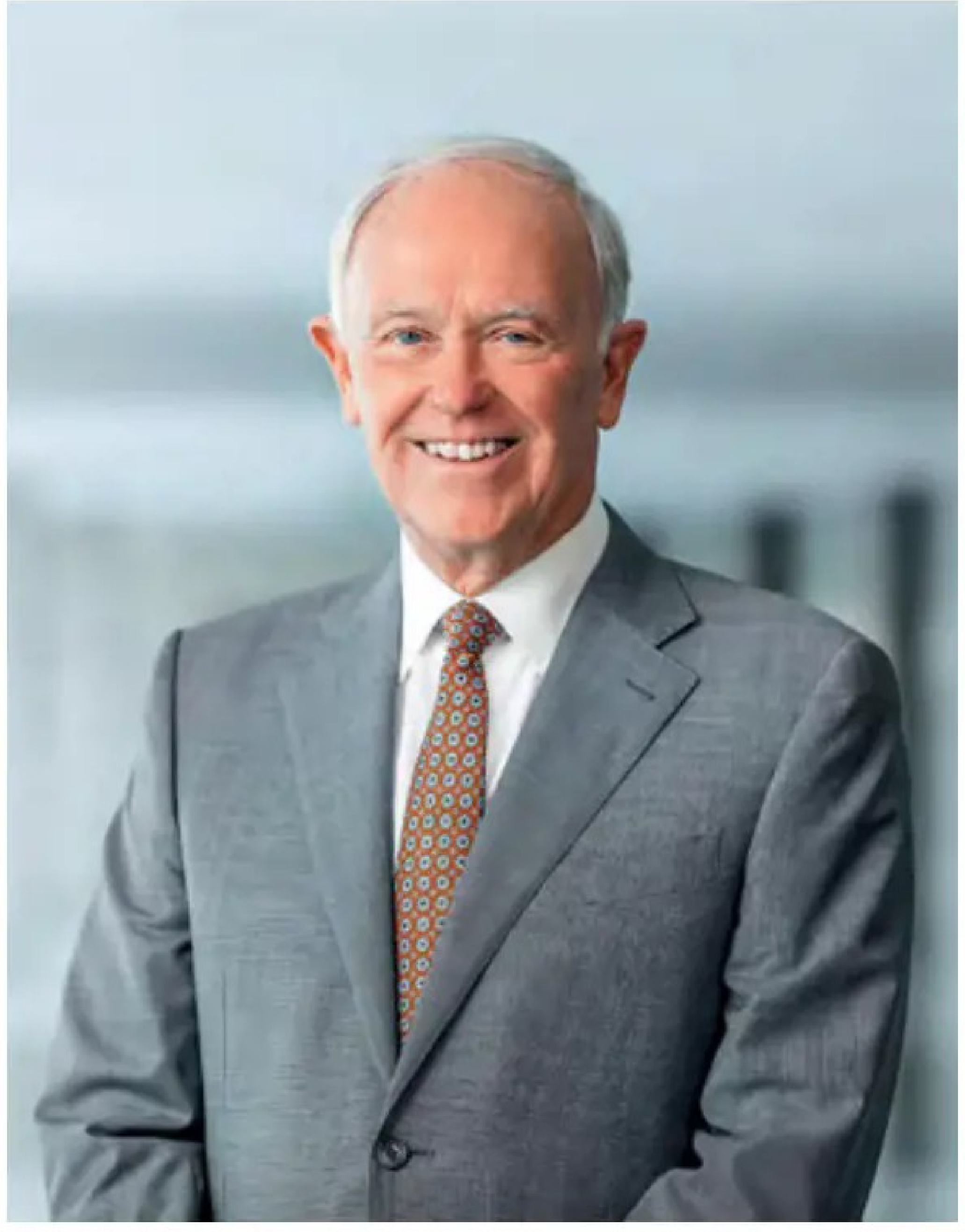
Vision

Sir Tim Clark was a key member of the team that launched Emirates and, for more than 20 years, he has led the airline to become one of the world's top carriers. **Michael Doran** spoke with him in Melbourne



ABOVE: *Sir Tim Clark said: "I rue the day the A380 was taken out of production"*

RIGHT: *Emirates is refurbishing the interiors of its A380s at its Dubai workshops* All images via Emirates

Running an airline is not a job for the faint-hearted. After an aviation career spanning more than 50 years, Sir Tim Clark has faced numerous tests and encountered significant challenges that will continue until he decides to pass on the baton.

Stable leadership combined with a clear and consistent vision is essential for any business's success. This holds especially true for Emirates Airline, whose two senior leaders have been with the airline since its inception in 1985.

The chairman and chief executive of Emirates Airline and Group, His Highness Sheikh Ahmed bin Saeed Al Maktoum, launched Emirates with two leased aircraft flying to two destinations from Dubai. Sir Tim Clark was a founding team member and head of airline planning before being appointed president of Emirates Airline in 2003.

Clark has been involved in aviation for more than 50 years and is renowned for his vision, aviation expertise and sharp insights into market trends and what resonates with customers. His career began with British Caledonian in 1972, followed by a position at Bahrain's Gulf Air before he joined Emirates.

During their time at Emirates, Sheikh Ahmed and Sir Tim have witnessed the airline's rise as one of the world's largest and most successful carriers. With a fleet of more than 250 widebody aircraft, Emirates operates flights to approximately 150 destinations across 80 countries and territories.

In its 2024 financial year, Emirates carried 52 million passengers at a load factor of 80 per cent and now employs nearly 67,000 people. It is a major sponsor of the Australian Open tennis tournament. While Clark was in Melbourne in January, *Air International* had the opportunity to talk to him about the airline and its future.

The cost of Boeing's 777X misfortunes

When talking to Clark, it soon becomes clear that he loves aircraft. He also

Emirates
AIRBUS A380-800
dnata

maker

CLOCKWISE FROM ABOVE:
With a fleet of 123 Airbus A380s, Emirates was quickly the most significant global operator

In January 2025, Emirates operated its inaugural A350 flight to Edinburgh

Delays with Boeing's 777X have forced Emirates to refurbish existing 777s

profoundly understands supply chains and the need for Emirates to forge its path through these turbulent times. Emirates has been directly impacted by supply chain disruptions and the problems at Boeing, which he described as being "unprecedented in aviation history". He told *Air International*: "In the past, we've had supply chain issues or stopped production through industrial issues, but in my 50-year aviation career, I've never seen anything of this scale happen. I've been on the Boeing case for quite a long time, and with the MAX problems and post-COVID, I thought this would not go away."

The uncertainty surrounding Boeing's 777X programme was of immediate concern. Emirates has ordered 210 of the as-yet uncertified widebody to replace its fleet of current-generation 777s. Clark has been a vocal critic of Boeing for some time about its lack of progress with the 777X, but with the existing 777s starting to lose their gloss, he realised some concrete action was needed: "We started assessing whether we should retain the fleet and our belief that Boeing could get through the situation and ramp up the contract in the timeframe we needed for fleet replacement and network expansion. The answer was clearly no, and I took that decision in the first part of 2021, so we started looking at tail numbers to see what it would take to retrofit them."

The issue was not technical; the ground-breaking cabins introduced on the 777s and A380s had started to fall behind Emirates' standards and what others were bringing to the market.

Clark said product development was like being at the tip of the sword. Features

pioneered by Emirates, such as sliding doors on business class suites, were now appearing on competitors' aircraft. He saw this as potentially damaging the Emirates brand, which meant that something had to be done with the existing aircraft.

"I said, don't worry about the cost, just get it done. So now we're retrofitting 200 aircraft, including the A380s, and this strategy speaks to the uncertainty of what the manufacturers will do for us over the next ten to 15 years. If you sit back and hope it will go away, it won't, so we've just got to get on with it.

"By now, I would have had just short of 100 777Xs under the original contract, which was signed in 2013, but I don't have one," he added. "We have to take that whether we like it or not, but the financial impact is US$4.5bn (£3.6bn) cash out of our own resources to do that."

Premium economy excitement

The work being done on the fleet involves retrofitting some aircraft that would have been retired with current products. Clark pointed out that the new aircraft will feature the latest innovations: "We've had to do what we can, but as to what we do in the future, I assure you that things will change. I have no problem once I've got them up and running and flying with a decent business class, with premium economy to take them back in, rip the first-class cabins out and do what we must."

One change that has emerged is the addition of a Premium Economy cabin in 2022, although that name barely captures the level of comfort Emirates provides. Customers enjoy a welcome drink in fine glassware, along with a selection of meals served on Royal Doulton china tableware with stainless steel cutlery.

The challenge in adding a premium economy cabin is to entice economy passengers to trade up rather than business class passengers to trade down, which Clark said would have been a disaster for the airline. By adding these touches of luxury, Emirates has achieved that goal, as 90 per cent of people in the premium economy have traded up from the economy. Demand is particularly strong on routes to and from Australia to the UK and Europe.

"We haven't got it on every aeroplane, but it has surpassed all expectations that we had to achieve to justify its inclusion by about 100 per cent. We took the A380 configuration from 517 seats to 484 to accommodate the premium economy, but the economics have proved exceptionally good."

On a four-class Emirates A380, the Premium Economy cabin is at the front of the main deck and has 56 seats in a two-four-two configuration. The retrofitted 777s have up to 24 Premium Economy seats in a dedicated cabin section between Business and Economy, and the Airbus A350 has 21 in a two-four-two layout.

"The design of the cabin in the A380 pushed the boat out in terms of premium economy compared to our competitors, with lots of real estate in the forward cabin. We put more cabin crew in, upgraded the food and drink with champagne and business class wines and made it a vibrant offering for passengers."

People want to travel

Despite the upheaval in the world and the rising cost of living, global travel demand continues to grow. Clark believes people's uncertainty about what will happen unnerves some, whether due to events in Gaza, Ukraine or Israel, but still people will travel. "Having been in this business all my life, I'm a great believer in its ability to meet and match the expectations of people who want to travel. If I look at what's happening in all the markets, and not just about Australia, it's South America, the United States and Europe, which is going through a particularly torrid time; people are getting on aeroplanes like they have never done before.

"We've added Bogotá and Madagascar, and we're broadening our horizons to make it easier for people to access these destinations. People, despite their domestic pressures, still desire to travel. At Emirates, we analyse where we anticipate demand will be, and I believe it will be substantial, though I wish I had a crystal ball!"

Clark also believes that the digital age is driving up demand for leisure

The 123rd Emirates

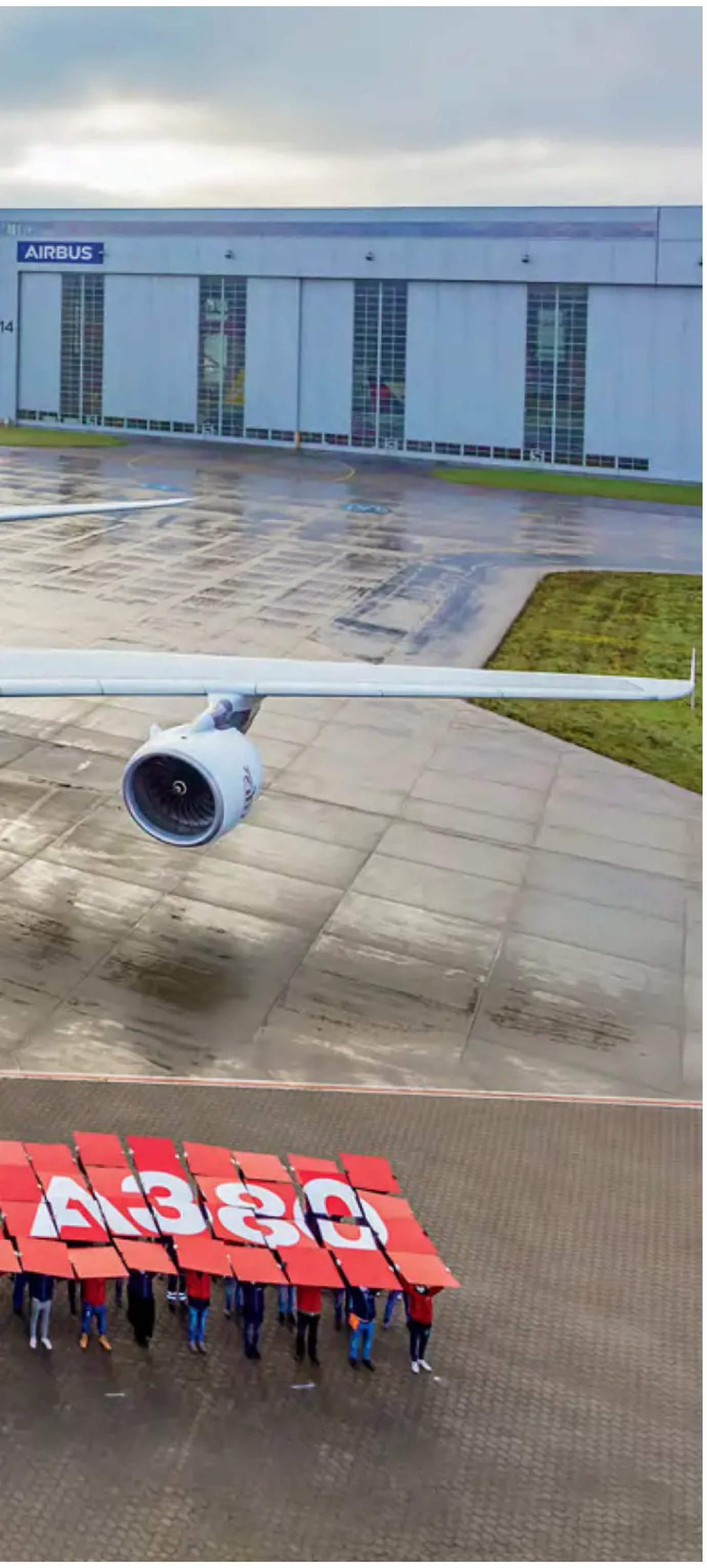
CLOCKWISE FROM RIGHT:
Emirates operates more than 250 aircraft to around 150 destinations in 80 countries and territories

The airline is upgrading its business class cabins to create a uniform standard across the fleet

The final Airbus A380 was the 123rd aircraft to join the airline

and business travel. He has never subscribed to the theory that video calls would eliminate corporate travel. He believes these platforms help connect people and initiate discussions about opportunities, which fosters business travel as relationships develop; he describes this as a paradox.

“I don’t think people get their minds around the more you communicate using the platforms we have, the more likely it is that people are going to



travel," he added. "As we expand our network, which we will eventually get to our new airport in Dubai, which will be a game changer, then it's going to be something that might be unstoppable, so I'm very bullish about it."

A380s: "You build them; we'll buy them"

It is hard to imagine the Airbus A380 without the support of Emirates, which between 2008 and 2021 received 123 out of the 251 delivered globally by Airbus. Sir Tim Clark is one of the biggest supporters of the A380, and as Emirates' president, he played a significant role in shaping the aircraft's design.

Clark defended the aircraft until Airbus decided to stop production after Emirates agreed to swap orders for 39 A380s for a mix of Airbus A350 and A330 widebodies in 2019. Emirates was the first airline to order the A380 in 2000, and its last was delivered in December 2021, ending its 21-year commitment to the programme.

Clark's confidence in the A380 has never diminished. He insists that with new engines and other upgrades, the aircraft has a place in commercial aviation. He even supplied Airbus with detailed design concepts for a new aircraft that he believed would be significantly cheaper to operate than the A380.

"I rue the day that it was taken out of production, and I still have designs in front of Airbus as to how they could build a new one which would be 25 per cent cheaper to run than this one," he told *Air International*. "They said, 'Well if you give us 20 million euros, we'll do it for you,' but I said, I fly them, you make them, and if you build them, we'll buy them."

Emirates is refurbishing 67 A380s to match the interiors of the final-built aircraft delivered in 2021. The work takes around 16 days inside the Emirates Engineering workshops in Dubai. It includes adding the new premium economy cabin and refurbishing the first business and economy seats and cabins throughout the A380.

Let's talk about sustainability

The prospect of unstoppable travel demand inevitably leads to a discussion on sustainability and aviation's global commitment to achieving net zero emissions by 2050. After attending numerous conferences and listening to experts discuss sustainable aviation fuel (SAF) as a cure-all, it is refreshing to hear Clark's opinion on the subject.

He takes a pragmatic stance, saying the realities of the situation are influenced by the fundamental physics of flight and the available technologies necessary to propel a 600-tonne aircraft through the air on 16-hour flights. The notion that this can be achieved with batteries or hydrogen is challenging for Clark: "If people want aeroplanes to fly, then there are certain things you'll need to accept.

"If somebody could give us 100 per cent of our fuel as SAF all the time, they would have to produce 550 million tonnes a year and, at the moment, they produce about 30. What is the upstream lost opportunity cost to produce that much, because if it is from agriculture you're converting food production, which is an important issue as populations grow."

That's not to say Clark or Emirates are not actively looking for ways to make aviation more sustainable, but the big question is how to do that. Emirates has already successfully trialled running engines on 100 per cent SAF, but the conundrum is how to produce it at scale.

"Emirates is growing its business, and there are many other carriers that have that aspiration going forward, driven by demand, so the more we do, the quantum increases," he explained. "We've done a lot of good, not just on our side of things, but I am not arguing for a carve-out for aviation because aviation still has much to do on the upstream build of what we do."

Opportunities in the Asia-Pacific region

One structural change post-pandemic has been a dip in travel from China, particularly to Southeast Asia and the US. However, geopolitical tensions between the two nations mainly drive the latter. Despite that, Asia-Pacific is already the largest aviation market in the world and, with India, it will continue to be the fastest-growing for some time to come.

"The planet requires goods and services coming out of the Pacific Rim, and apart from China, you've got Vietnam, Cambodia, Indonesia and Thailand, so we have significant aspirations for the Pacific Rim operation. We want to go into Korea much more than we do, but we can't persuade the Koreans to let us have more flights in there."

Clark agrees that the Chinese market is down, but he is confident it will eventually bounce back, mainly because China produces around 60-70 per cent of all goods. Emirates is trying to open more destinations in China and is making headway, but slot congestion at the times the airline needs is a barrier.

"So, when I look at that area in the whole sort of theatre, it is enormously powerful for Emirates, and so long as we get the aeroplanes that we need to do it, we'll be out there doing a lot more than we are doing today. With the A350, we now have a 300-seater that's very economical to operate and allows us to pick off a few more of the third-level points in Asia; it's just a question of getting the aeroplanes."

ABOVE: *The fleet has successfully operated using 100 per cent SAF from Neste*

RIGHT: *The Emirates Flight Training Academy in Dubai trains cadets from ab initio to an ATPL licence*

Emirates is building its own pilot pipeline

Panel bodycopy With a fleet of more than 250 aircraft and another 310 on order, Emirates is continually building up its cohort of pilots through the Emirates Flight Training Academy (EFTA) in Dubai. The academy was founded in 2017 and, since then, it has transformed 271 cadets with no flying experience into world-class professional pilots.

The EFTA plays a vital role in nurturing the next generation of pilots, not only for Emirates or the UAE but also for world aviation. The academy's facilities are unrivalled, with its own airport and air traffic control tower, fire and rescue services, maintenance hangar and state-of-the-art training and simulator facilities.

Cadets begin flight training on Cirrus SR22 G6 aircraft and advance to the Diamond DA 42 NG-VI, featuring twin engines, a streamlined all-composite frame and an advanced flight control system. The significant progression occurs with the Embraer Phenom 100EV, which prepares cadets for multi-engine jet operations.

Cadets undergo an integrated ATPL (Airline Transport Pilot Licence) programme that encompasses ground school, line-oriented flight training, multi-crew co-operation (MCC), and both single-engine and multi-engine flight training. Throughout this process, they obtain an Instrument Rating (IR), Multi-Engine (ME) and Commercial Pilot Licence (CPL) before advancing to Jet Orientation and MCC as they shift towards airline operations.

In December, the EFTA graduated 85 new pilots, its biggest cohort to date. The group included 67 UAE national and 18 international cadets. Every cadet completed around 113 weeks of training, with more than 1,100 hours of ground-based and 270 hours of flight training.

It also announced the introduction of an Advanced Diploma in Pilot Licensing Training, which will provide aspiring professional pilots with a strong academic foundation. With 94 credit hours, the diploma allows cadets to pursue bachelor's and master's degrees from any university.

Emirates is already determining where it wants to open new routes over the next 15 years, but no leader, especially one as seasoned as Clark, will divulge that information. He did point out that Emirates carries many people from the East Coast of the USA to Thailand, and there is demand for onward flights to Perth, Western Australia.

"There is also a lot of scope as we open up more in the US and as we open up more in South America and Africa, then things will really start to move. We will be connecting city pairs that, at the moment, you can't actually travel to, or if you do, it is every other or every third day. That attracts people, so I think going forward, all of this is in the mix for Emirates."

He expressed no concerns about the partnership between Qatar Airways and Virgin Australia, which will see the Australian airline operating flights to Qatar using aircraft wet-leased from Qatar Airways. There is no issue about Virgin Australia picking up open rights to fly between Australia and the Middle East. Still, some eyebrows were raised about doing it via an extended wet-lease arrangement.

He said: "There's nothing wrong with competition. Competition is good for the consumer and sharpens how we go about our business. The Australian government should decide on the way the wet-lease works. Circling back to Virgin, Qatar, Qantas and Emirates, there's room for all, and you have to make the accommodations for that.

"We are free and don't have any subsidies of any kind, so we just have to make our own way. In the end, if sense prevails in the way you go about your capacity and your pricing of that capacity and the product range you offer, it's always if you get the 'sweet spot' and if you get it right, it works." **AI**

The Baltics – NATO's

Former RAF pilot and industry defence consultant **Paul Kennard** assesses where NATO needs to step up and prepare for a Russia that's now keen to increase its influence and dominance beyond its own borders

In the 20th century, the Balkans were often regarded as the 'tinderbox of Europe'. This region served as a crossroads for empires that exchanged goods and power, each striving to exert influence through proxies to expand their dominance further or simply to undermine their distant relatives who governed imperial rivals. The 'kindling of conflict' comprised a volatile mix of religion, nationalism, and factionalism. Many feared it would only take a spark, or a moment of unfortunate 'stray voltage', for a continent-consuming conflagration to ignite. Gavrilo Princip, a Bosnian Serb, fired two shots from his FN Model 1910 .380 ACP pistol at point-blank range at Archduke Franz Ferdinand of Austria and his wife, Sophie, on a summer's day in Sarajevo, proving to be that very spark.

In today's climate of heightened tensions in Europe, it is not merely 'some damn foolish thing in the Balkans' (as described by Otto von Bismarck) that seems most likely to provoke a continental conflict; rather, many observers and commentators are highlighting the Baltic States of Estonia, Latvia, and Lithuania.

Why?

Russia's 'Special Military Operation' (SMO) is now in its third year. The 'quick win' undoubtedly envisaged by the Russian leadership has failed to materialise. They find themselves embroiled in a protracted war of attrition, where progress is measured in metres rather than miles, and each advance incurs an exorbitant cost in blood and treasure. Russia has likely haemorrhaged much of its initial first-choice manpower and equipment, acquiring a meagre 20% of Ukrainian territory, and, embarrassingly, has also suffered the indignity of being invaded for the first

new front line?

DANGER-FAN INTAKE-DANGER
RESCUE
024
DANGER
JET INTAKE DANGER
AIRCRAFT ARMED
DANGER

The RAF first deployed its F-35Bs to Ämari Air Base in Estonia in 2022. At that time, they participated in Enhanced Vigilance Activity (eVA) in the Baltic region, which contributed to NATO's increased presence due to the evolving regional security situation. Tensions in the region have only escalated since then
All images UK MOD Crown Copyright

RIGHR:
Intercepts involving Russian fighters take place almost daily in the Baltic skies, as Russia occasionally seeks to provoke NATO patrol aircraft with perilous manoeuvres despite internationally agreed procedures

BELOW:
RAF Typhoon pilots have never been busier operationally, undertaking regular deployments to the Baltic region as part of NATO's commitment to deterrence in the region

time since 1941, with Ukraine's incursion into the Kursk Oblast. Nothing signifies a 'faded superpower' more than having to solicit assistance from countries such as Iran and North Korea for soldiers and weaponry, even after the Kremlin has effectively placed the Russian economy on a war footing. There must be a tangible return for the loss of manpower, equipment, and global reputation for the regime to endure.

Desperate people desperate choices

Could the Russian government consider a strike on the Baltics as a means to provide its people with the 'swift victory' promised in 2022? The Russians I have encountered possess a profound sense of history. However, a strong belief in myth and nostalgia often distorts it, reinforced by an educational curriculum

that exaggerates both elements. Until the dissolution of the Soviet Union in 1991, the Baltics were effectively occupied as part of the USSR, having been annexed in 1940 as specified in the Molotov-Ribbentrop Pact by falling into the designated ‘Soviet Sphere’ of Europe. In the eyes of many Russians, they still belong to ‘Mother Russia’ and were carelessly surrendered during the chaos following the immediate post-Soviet collapse. According to the latest estimates, there are approximately 900,000 native Russian speakers in the Baltics, and the Russian government has already issued a series of stern statements regarding their treatment – some unnervingly reminiscent of the ‘shaping operations’ in the years leading up to the invasion of Ukraine in 2022. Criticism has arisen over mandatory language tests, the destruction of Soviet World War Two memorials, and the unfair treatment of ethnic Russians. Notably, during the unveiling of a memorial to Soviet victims of ‘Nazi genocide’ in January 2024, the Baltics were accused of ‘embracing Nazism’ and treating Russian minorities as ‘subhuman’. Such evocative and inflammatory language is aimed squarely at the hearts of the Russian populace, with the added consequence of raising concerns abroad.

Furthermore, there is the issue of the Kaliningrad Oblast – a Russian territory centred on the former Prussian city of Königsberg, which is isolated from Russia as Poland and Lithuania encircle it. Much like post-war Berlin, it is accessed via a corridor – in this case, the Suwalki Corridor, which runs through a gap of the same name between Belarus and Kaliningrad. Since the invasion of Ukraine in 2022, the area has seen an increased military presence from both sides – it is a tinderbox within a tinderbox in many respects.

But the Baltics are not Ukraine

What the Baltics lack in space, they more than make up for with ‘friends’. Since their liberation from the Soviet yoke, the Baltic States have decisively oriented themselves towards the West, rather than the East. Following years of negotiations and restructuring, they became members of NATO and the EU in 2004. NATO membership provides security guarantees, including the ultimate provision of Article Five – that ‘an attack on one is an attack on all’.

However, this has not, it seemed, prevented Russia from utilising its ‘grey zone’ operational playbook against the region. Disinformation, propaganda, cyber warfare, and suspicious maritime activity, particularly involving underwater cables, have all increased since the start of the SMO. If the Baltics are Russia’s next target, what can NATO do to stop it?

The first line of defence is always a robust deterrent. In contrast to Ukraine, the Baltic states simply lack the land mass necessary to execute a series of tactical withdrawals to successive, pre-prepared firing positions and ‘kill zones’ – essentially exchanging territory for time while inflicting maximum attrition on the invaders. Therefore, showcasing a credible initial fighting capability to thwart an attack is vital in preventing an opportunistic invasion. I have little doubt that Russian planners have learned significantly from their unequivocally titled Zapad *(West)* military exercises in 2017 and 2021, which simulated the closure of the Suwalki gap, providing a land route to Kaliningrad and isolating the Baltics from Poland – their only land border with NATO.

Airpower plays a key role in this deterrence

Shortly after the Baltic States joined NATO in 2004, the Alliance established the Baltic Air Policing (BAP) detachment. Initially based at Šiauliai Air Base (also known as Zokniai) in Lithuania, the size and scope of the force expanded with the deployment of additional units to Ämari Air Base in Estonia following the Russian annexation of Crimea in 2014. The BAP operates under the Operational Control (OpCon) of the NATO Combined Air Operations Centre (CAOC) in Uedem, Germany, from which orders to launch the quick reaction alert (QRA) aircraft are issued. Russian aircraft are frequently intercepted while en route to and from Kaliningrad, often flying very close to NATO airspace without making radio calls, filing a

CLOCKWISE FROM RIGHT:

Spain utilises its regular Baltic Air Policing deployments to carry out valuable training, deploying either its Eurofighter Typhoons or older F/A-18s

NATO assets, including the E-3 Sentry AWACS, are nearly a permanent fixture in the region, offering surveillance and, if necessary, target detection and allocation of Russia's forces

In March 2024, Sweden became a full member of NATO, enhancing the organisation's capabilities and significantly reducing the vulnerability of its northeastern flank. The Swedish Air Force's JAS-39 Gripens regularly support NATO's air policing detachments

flight plan, or activating transponders. Undoubtedly, Russian signals and communications intelligence (SIGINT/COMINT) systems are on alert, 'sniffing' for valuable intelligence and measuring response times. Simultaneously, Russian crews will note the aircraft type and loadout of the intercepting fighters.

Over the years, the participating fighters have evolved. According to NATO's articles, each country with suitably equipped aircraft and trained crews is obliged to support the four-month deployment cycle. The UK RAF has conducted numerous BAP missions since their inception, beginning with a combined detachment from 11 and 25 Squadron at RAF Leeming, employing Tornado F.3s in 2004 and transitioning to the Typhoon for rotations in 2014, 2015, 2016, 2019, 2020, and 2023. Several nations, including Poland, Portugal, Belgium, Romania, Denmark, Norway, and Turkey, have deployed F-16s, while other Typhoon operators (Germany, Italy, and Spain) have contributed their aircraft. The RCAF has sent CF-188 Hornets, Spain has contributed 'classic' F/A-18s, and the Czech Republic and Hungary have supplied JAS 39 Gripens. France has provided Mirage F1s, Mirage 2000s and Rafales, while the USAF has deployed F-15s and F-16s. Due to the extended duration of the BAP mission, several intriguing older airframes have also been utilised: the Poles have rotated MiG-29 *Fulcrums* several times, and the Germans have deployed their F-4F Phantoms on at least three occasions.

A watershed moment came in April 2021, when Italy deployed four F-35A Lightning II fifth-generation aircraft to Ämari. Since then, the RNLAF has also sent F-35As on two occasions. Indeed, as this article is being drafted, Dutch F-35As are holding the BAP task at Ämari, while French Rafales are based at Siauliai. The number of aircraft on each detachment varies with national and service needs. Some nations use BAP as an opportunity to conduct valuable training – often with aircraft from nearby Poland – and Spain has deployed as many as eight Typhoons or F/A-18s. Others send the minimum required to hold a two-jet 'Q' with 'spares'. The usual commitment is four airframes, but for aircraft with perhaps more maintenance issues (such as the ageing F-4F Phantom) as many as six might deploy.

BAP constitutes very much a 'tripwire' and a show of force. Although the performance of the VVS (Russian Air Force) has faced considerable criticism regarding its platforms and tactics, techniques, and procedures (TTPs) in Ukraine, it remains capable of concentrating large numbers of modern aircraft equipped with contemporary sensors and weapon systems. The

four-to-eight jet BAP detachments, even if manned by F-35As, would soon be overwhelmed by a mass Russian assault – with the VVS likely to accept 'trading' at a ratio of six-to-one, or more, against NATO's arguably more advanced platforms and better-trained crews. Unless operating in 'Beast Mode' the F-35A is limited to a gun and four internal AIM-120 AMRAAM missiles (six if equipped with the SideKick upgrade – which is not an option for the F-35B's smaller weapon bays). Even assuming a high probability of kill (PK) of 90%, the BAP would 'Winchester' (run out of ammunition) before the VVS exhausted its jets. Consequently, if a credible threat to the Baltic States were detected, NATO would need to act swiftly to reinforce its forces. Additional fighters would, undoubtedly, be deployed to bolster

ABOVE:
The region's strategic significance meant that the USAF deployed its F-22A Raptors for regular exercises. With the new US leadership in the White House poised to amend its collaboration with NATO, will these highly capable fifth-generation platforms continue to provide support?

RIGHT:
The Chinook's capacity to swiftly transport personnel and supplies across the battlefield will be crucial for maintaining a high-tempo defence. The Chinook force has consistently deployed to the region over the past few years for training exercises

the BAP detachments –possibly operating dispersed at non-military airfields or even employing Agile Combat Employment (ACE) techniques, as recently demonstrated in Finland, where F-35s and Typhoons collaborated with the Finnish Air Force's F/A-18s in operating from strips of highway.

In the event of increased tension, NATO would undoubtedly establish a series of 24-hour airborne early warning and control (AEW&C) orbits using E-3s. However, in the near future, some orbits could be provided by the E-7 Wedgetail ordered for the RAF and USAF, as well as potentially the SAAB 340 AEW now that Sweden is a full NATO member. Each AEW&C orbit would likely include accompanying combat air patrols (CAPs) to protect the high-value air asset (HVAA) from attack and be prepared to reinforce the deployed aircraft or respond to an off-axis threat. NATO's would-be opponents recognise the value of AEW&C aircraft to the organisation. They serve as force multipliers and battle directors, ensuring maximum efficiency in aircraft use and optimal engagement parameters for NATO's weapons.

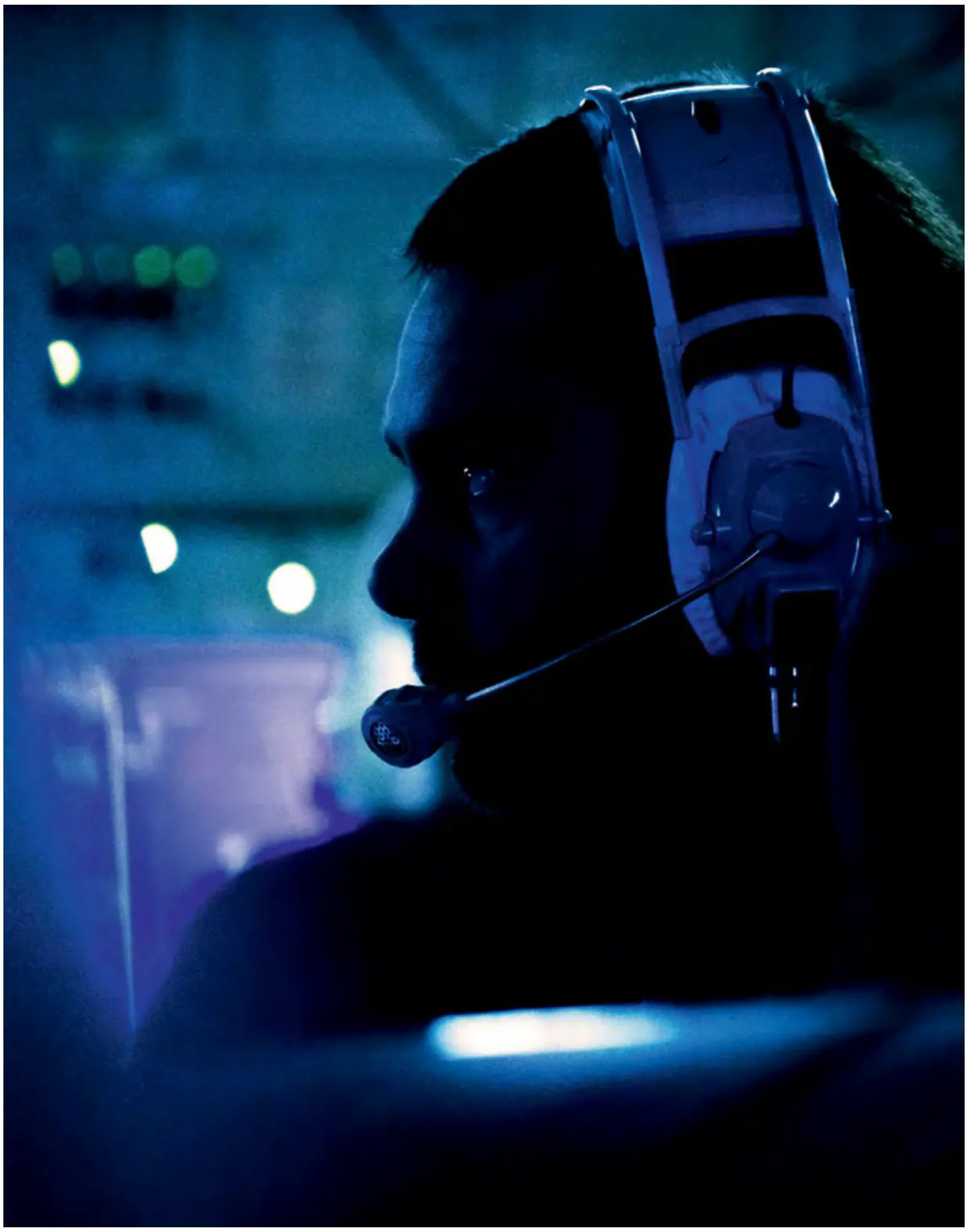
Intelligence overwatch

Consequently, they and other HVAAs, such as intelligence-gathering platforms and air-to-air tankers, are important targets. 'HVAA Killer' long-range missiles have been under development in both Russia and China. The Chinese PLAF have recently been observed conducting exercises with the PL-17 air-to-air missile (AAM) mounted on the J-16 fighter, a Chinese licence-built Su-27/30 *Flanker*. The PL-17 is significantly larger than the PL-10 IR missile and the PL-12 and PL-15 radar-guided weapons. The PL-15 is regarded as a Meteor equivalent, boasting a range of around 150km, but the PL-17 has been reported in diplomatic circles to possess a range of 400km. In the deadly dance of modern air combat, even the threat posed by a weapon like the PL-17 could deliver something of a 'soft mission kill' – forcing the AEW&C, ISR, and tanker orbits back far enough to substantially diminish their effectiveness in supporting NATO's tactical aircraft. Russia has also developed long-range AAMs to challenge NATO's vulnerable support aircraft. The R-37 (AA-13 *Axehead*) also claims a range of 400km. A combination of R-37s and PL-17s could compel NATO's tactical aviation to operate blind and with relatively short 'legs' at the front.

The air battle is crucial to any modern campaign, but wars are rarely won in the air; they are won on the ground. Air power also has a key role in deterring Russian adventurism in the Baltics by providing air mobility and Close Air Support (CAS) to NATO troops deployed in the region. The message from NATO is clear: the moment Russia dares to cross the border, they will face NATO forces from beyond the Baltic States – effectively creating an immediate, de facto Article Five scenario. Without a deep hinterland to retreat into, NATO forces must focus on thwarting any Russian advance almost immediately. In simple terms, this means destroying a significant number of tanks swiftly, targeting Russian UAVs conducting reconnaissance, and, finally, striking the long-range artillery and rocket systems that hit the targets identified by the UAVs.

This presents a multi-axis threat to NATO. Russia possesses significant combat forces in the Kaliningrad Oblast, including long-range missiles. Any Russian assault should be assumed to involve raids or missile attacks from Kaliningrad. Thus, NATO must prepare for such a threat, potentially by deploying Theatre Ballistic Missile Defence (TBMD) systems such as Patriot Advanced Capability (PAC-3) and Terminal High Altitude Area Defense (THAAD) on land or suitably equipped warships in nearby waters.

The role of NATO tanks, infantry, and artillery is to stop the armoured advance. All units must be resupplied and frequently moved quickly for tactical effectiveness. NATO's battlefield helicopters will be pivotal in facilitating this manoeuvring strategy. The UK has consistently deployed its CH-47 Chinook helicopters to the Baltics, providing tactical airlift to NATO's 'Enhanced Forward Presence' under Operation Paleda. The Chinook's ability to rapidly transport personnel and supplies across the battlefield will be crucial for sustaining a high-tempo defence aimed at achieving significant attrition. Transporting



ABOVE:
The UK has committed both air and naval resources to the Baltic region, with both working in partnership to monitor and collect as much intelligence as possible on Russian military assets and operational doctrine in the area

RIGHT:
For the foreseeable future, RAF Typhoons, as part of NATO, will continue to patrol the tense skies above the Baltic, ready to respond to any moves by Russia

fire teams, anti-tank weapons, and special forces along the front line will be essential, as will enabling 105mm guns to carry out ‘shoot and scoot’ fire missions. Unfortunately, but inevitably, the aircraft will also resume the medevac role it effectively undertook in Afghanistan.

The Chinook is not the only Joint Aviation Command helicopter deployed to the Baltic States. Exercise Swift Response in April 2024 involved Wildcat and Apache helicopters, alongside Puma UAS operated by the Royal Artillery (not to be confused with the medium-lift helicopter), which joined the Chinooks in the region to support a total UK commitment of 20,000 personnel as part of a 90,000-strong force drawn from all 32 NATO members. Swift Response was merely a component of a far more extensive, year-long NATO exercise, Steadfast Defender, which harked back to the extensive seasonal exercises conducted during the Cold War. The Wildcats and Puma UAS were tasked with battlefield surveillance duties, particularly in identifying targets for the Apache’s formidable weapon systems. In a deteriorating situation, NATO would undoubtedly deploy numerous Attack Helicopters from member nations to the Baltics, along with tactical reconnaissance assets - operating on the premise that many of the HVAA ISR platforms would have been pushed back by the threat of long-range AAMs or forward-deployed long-range A2AD (Anti-Access/Area Denial) SAM systems, such as the S-400 Triumf (SA-21 *Growler*) and the new S-500 Prometheus.

If available, A-10 Thunderbolt IIs would likely be deployed to areas surrounding the Baltics, if not stationed locally. Their

prodigious tank-killing prowess adds considerably to the lethality of platforms such as Apache and Tiger. Provided NATO's fighters and Integrated Air Defence System (IADS) can wrest some measure of air control from the VVS, and SEAD platforms and Jammers degrade Russia's A2AD and mobile SAM/artillery systems (as Israel and Ukraine have demonstrated), it could be a very bloody first encounter with NATO for Russian armoured columns. The experience will, I don't doubt, prove more lethal than meeting NATO's 'Second XI' equipment used by rapidly trained troops in Ukraine. Struck relentlessly, 24/7, from the air by fixed and rotary wing aircraft, sniped by the side by rapidly moving vehicle and helicopter-borne Javelin teams and, finally, confronted by well dug-in NATO tanks in pre-recce'd 'kill zones', there is every chance that a rapid drive to Riga, Tallinn or Vilnius would prove just as ineffectual as the attempted 'thunder run' to Kyiv via Hostomel airfield on the opening day of the Ukraine war – and likely even more chastening.

Counter-UAS (C-UAS) plays a crucial role in degrading Russian situational awareness (SA) and reducing the effectiveness of its long-range fire capabilities. Learning from lessons in Ukraine, the UK is now discussing doctrine centred around 'poking the enemy's eyes out' by deploying C-UAS effectors 'up threat'. These include a variety of ground-based guns, RF, and directed energy systems, which will eventually appear on numerous air platforms. The Wildcat has recently demonstrated its ability to target and destroy UAVs using Martlet missiles, while French Navy Panthers have achieved 'kills' against Houthi drones in the Red Sea. The recent mass drone assault on Israel was mitigated mainly by manned fighter aircraft. Therefore, it is reasonable to expect that the C-UAS 'fight' will become a critical element of 'control of the air' in any future campaign, not solely in the Baltics.

As we perhaps peer into the potential abyss of a full-scale conventional war between Russia and NATO in the Baltics, it may be wise to consider how such conflicts commence and how the risk of escalation is far greater in these troubled times than ever before. Gavrilo Princip's FN pistol is on display at the Museum of Military History in Vienna, Austria, as part of a superbly curated yet chilling collection that includes the Archduke's car, uniform (with bullet hole), and the chaise longue on which he died. It serves as a stark reminder of how all-consuming flames can ignite from a mere spark. **AI**

More than one billion litres of SAF were produced in 2024 Neste

green

The game

Mark Broadbent looks at the current status of sustainable aviation fuel production

The International Air Transport Association (IATA) has revealed that around one million tonnes of sustainable aviation fuel (SAF) – equating to 1.25 billion litres – was produced worldwide in 2024. This was a further step forward for these new fuels. According to IATA, only 480,000 tonnes of SAF were produced in 2023, which was an increase from the 280,000 tonnes produced in 2022. These production ramp-ups seem impressive, indicating large investments from fuel suppliers to expand production capacity and airlines signing offtake agreements from SAF producers.

According to IATA, currently there are 160 SAF projects. Data from the International Civil Aviation Organization – correct to February 25, 2025 – said there are now 143 offtake agreements between airlines and SAF providers. In the long term, IATA estimates that SAF could contribute around 65% of the reduction in carbon dioxide emissions aviation needs to achieve to reach net zero in 2050.

A January 2025 paper, *European Industrial SAF Policy*, from the consultancy firm ICF noted: “Following decades of development, SAF production is gaining momentum, with production

norsk e-fuel
ing the transition to
enewable aviation!
BOEING
SU
AERO
TOGET

CLOCKWISE FROM ABOVE:
ICAO says fuel providers have 143 sustainable aviation fuel agreements with airlines Airbus

Neste is planning to produce 1.2 million tonnes of SAF each year at its Rotterdam refinery, Europe's largest renewable fuel factory Neste

Boeing announced a partnership with Norsk e-Fuel to produce advanced SAF using power-to-liquid refining Boeing

volumes forecast to reach 16 million tonnes in 2030."

There have been other announcements about plans to increase SAF production. In February 2025, the Singapore Airlines (SIA) Group signed a memorandum of understanding to source SAF from Aether Fuels, which plans to set up production plants in the United States and Southeast Asia. When Aether's plants begin commercial production, SIA Group intends to procure neat SAF for five years, with an option for a five-year extension.

Aether's neat SAF will be blended with regular Jet A-1 before being supplied to selected airports served by Singapore Airlines and Scoot. A statement said: "Aether will use waste carbon feedstock to produce the fuel, employing its innovative and proprietary Aether Aurora technology. This method reduces plant capital cost, increases production efficiency and achieves higher SAF yields compared to existing techniques."

Enormous gap

Despite airlines taking up SAF and the progress on manufacturing, a considerable uplift in annual production would be required to meet long-term objectives. IATA says the 1.25 billion litres of SAF produced in 2024 fuelled only around 800,000 flights – a fraction of the 40.1 million commercial flights globally over the year.

Alexander Kueper, vice president of renewable aviation business at Neste, told *Air International*: "We have an enormous gap to cover to get to the 400+ million tonnes of SAF the industry would need in 2050, and we need to accelerate the ramp-up of production. With the aviation industry having surpassed pre-pandemic levels and resumed its growth path, reducing its climate impact and ramping up SAF production and usage is more urgent than ever."

Production pathways

According to IATA, SAF can reduce carbon dioxide emissions by up to 80% compared to conventional fossil-based aviation fuels: "[SAF] can be produced from a number of sources (feedstock), including waste fats, oils and greases, municipal solid waste, agricultural and forestry residues, wet wastes, as

well as non-food crops cultivated on marginal land. It can also be produced synthetically via a process that captures carbon directly from the air. SAF can be considered 'sustainable', as its feedstocks do not compete with food crops or output, nor does it require incremental resource usage such as water or land clearing, and, more broadly, it does not promote environmental challenges such as deforestation, soil productivity or biodiversity loss."

However, Kueper said that SAF produced with hydrotreated esters and fatty acids (HEFA) is currently "the only commercially viable pathway" for sustainable fuels. Neste refines vegetable oils, waste oils and fats into HEFA fuel at its refineries in Porvoo in Finland (the company's first facility, opened in 2007), Rotterdam in the Netherlands (opened in 2011) and Singapore (opened in 2016). Kueper said the company has increased its SAF production capability across these refineries to 1.5 million tonnes (18.7 million litres) in 2025.

The Rotterdam refinery currently produces 1.4 million tonnes of renewable products – not just SAF – per year, making it Europe's largest renewable fuel factory. An upcoming capacity expansion will increase output to 2.7 million tonnes per year in 2026, of which 1.2 million tonnes will be SAF.

Kueper said: "Independent surveys like the World Economic Forum Clean Skies for Tomorrow report estimate the global availability of waste and residue oils and fats will exceed 40 million tonnes by 2030. This will provide enough raw material to significantly ramp-up SAF production.

"At the same time, we need to work on developing as broad as possible a feedstock pool to further increase production. Neste is also working on that, looking into future production technologies, as well as new future raw materials such as novel vegetable oils and lignocellulosic residues like forestry waste."

More must be done

Investment is foremost among the various challenges involved in scaling up SAF production. Kueper said developing SAF facilities is highly capital intensive: "The expansion of Neste's renewable refinery in Rotterdam, the Netherlands, is an investment of around €2.5 billion."

The ICF paper *European Industrial SAF Policy* noted: "Decarbonising aviation will require the SAF industry to attract cumulative investment of up to €3.7 trillion by 2050, overcoming challenges across technology, market risks and feedstock access."

In Europe specifically, ICF said: "The European Union has built a sophisticated policy framework to support SAF demand. The ReFuelEU Aviation regulation mandates fuel suppliers to blend increasing volumes of SAF into the EU's jet fuel supply, with a sub-mandate for synthetic SAF produced from low-carbon electricity. [However] more must be done for the EU to maintain industry leadership and achieve climate targets."

The industrial strategies implemented in China and the United States have accelerated investment in SAF in both countries, ICF noted: "The combination of supportive policies, such as the Inflation Reduction Act in the US, and cheap energy, loans and other mechanisms in China have created an unequal competitive landscape. This is further tilted against EU producers through disadvantages in several fundamental factors, such as electricity prices, construction costs, permitting times and access to feedstocks. In the absence of additional measures, EU refineries will face intense competition and growing quantities of SAF are likely to be imported to meet the ReFuelEU Aviation mandate. European customers will shoulder the cost burden, but an increasing share of jobs will be created in other countries and the EU will remain dependent on foreign providers for energy."

The consultancy's paper also highlighted a further, more fundamental challenge for the SAF industry – the lagging development and investment in advanced SAF, the synthetic fuel produced from low-carbon electricity generated using renewable and scalable feedstocks. A combination of price uncertainty and technology and policy risks have held back investment, opening the potential that obligated parties will fail to meet the mandate: "In this worst-case outcome, costs are driven up for consumers with no environmental benefit. The EU should implement additional measures to break this stand-off, unlock private investments and ensure advanced SAF technologies can scale to meet the required volumes, while maintaining aviation connectivity at an appropriate price."

Risk-sharing

Six organisations from the European civil aviation industry jointly commissioned the ICF report: ACI EUROPE, A4E (Europe's largest airline association), ARC (Airport Regions Council), ASD (Aerospace, Security and Defence), ERA (European Regions Airline Association) and GAMA (General Aviation Manufacturers Association). According to a joint statement, a concerted policy push could boost SAF production.

CLOCKWISE FROM ABOVE:
Finnish company Liquid Sun's founders say it is "accelerating the commercial viability of e-fuels" Liquid Sun

Liquid Sun's founders Liquid Sun

Liquid Sun aims to develop synthetic feedstock production for sustainable aviation fuels through low-temperature electrolysis Liquid Sun

The report put forward recommendations in four key areas:

- Risk-sharing mechanisms, such as Contracts for Difference, should be introduced to unlock private investment and reduce consumer costs
- Enhancing financial support for advanced SAF facilities, including capital grants and loan guarantees
- Prioritising access to feedstocks and renewable electricity to ensure sustainable and competitive production
- Refining existing mechanisms by adding flexibility to the ReFuelEU Aviation mandate and EU Emissions Trading Scheme (ETS) to improve market efficiency and reduce volatility.

The ICF report provided more detail on each of these points. Regarding risk sharing, the report said: "Risk-sharing mechanisms would unlock private investments while reducing costs for consumers. Contracts for Difference have proven effective for the wind [energy] sector, and carbon contracts for difference are increasingly implemented within the EU to support green hydrogen, carbon capture and other emerging technologies."

Regarding financial support, ICF noted that the United States, UK, Australia, and Japan have programmes to support the capital-intensive process of building SAF production facilities: "Grants or loan guarantees can encourage private capital and could be provided through adjustments to existing schemes – for example, by adjusting criteria in the EU ETS Innovation Fund to recognise the unique nature of SAF projects".

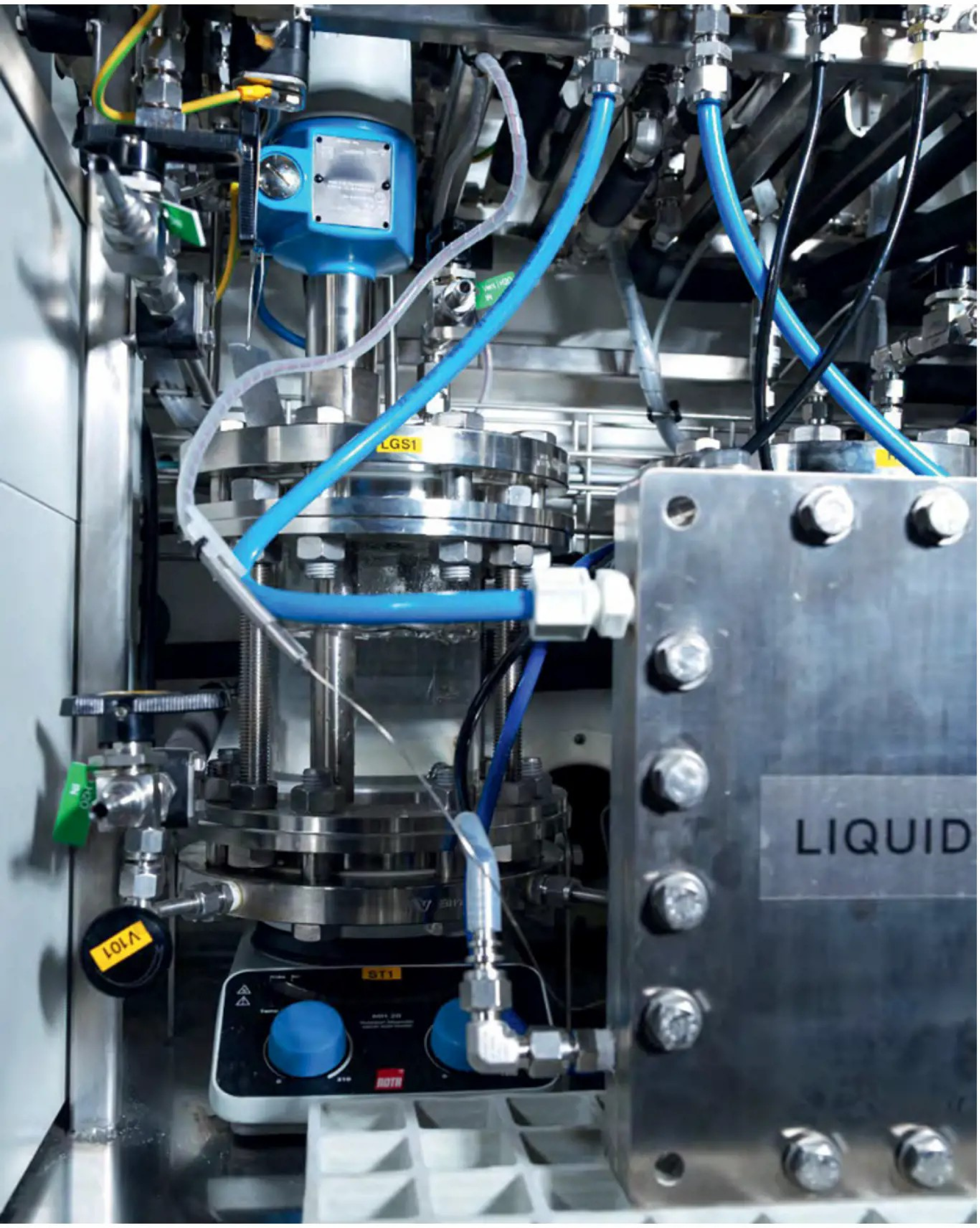
Access and advanced SAF

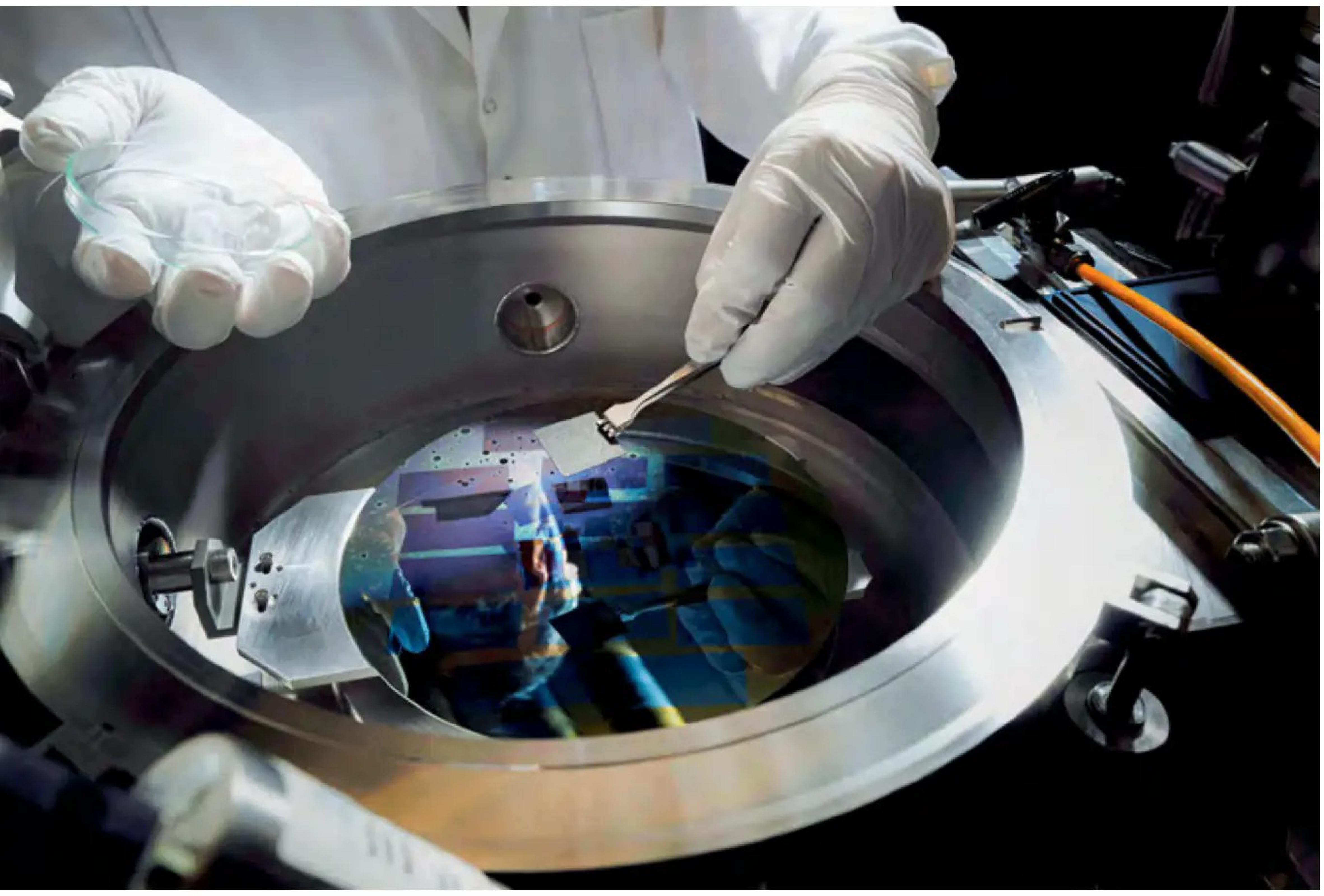
Sustainable fuel depends on sustainable feedstocks, and the ICF said ensuring access to these is an important issue for aviation: "Policies should account for the limited alternatives to decarbonise hard-to-abate sectors such as aviation, ensuring the available feedstocks are efficiently allocated."

ICF said advanced SAF is "an effective foundation for the SAF industry." However, commercialising it has proven challenging "due to higher production costs and risk profiles. Measures must be amplified to make advanced SAF investable by providing revenue certainty and targeted support, allowing bankable offtake through improvements to the ETS allowance scheme, and increasing their multiplied contributions. This support is crucial to reducing dependence on constrained feedstocks and diversifying production opportunities.

"The electricity required to meet the synthetic SAF sub-mandate must be accounted for within the EU's energy supply plans, and mechanisms should ensure producers can access electricity at globally competitive prices. Biogenic wastes and residues should be prioritised for sectors with few alternatives."

In January 2025, Boeing and Norsk e-Fuel announced a partnership to produce 'green' SAF using fossil-free





power and recycled carbon dioxide from biogenic sources. Boeing stated that the lifecycle greenhouse gas emissions of e-SAF are “over 90%” lower than those of conventional jet fuel.

In February 2025, carbon capture specialist Soletair Power said it had delivered air-captured carbon dioxide to Liquid Sun, a fellow Finnish company that describes itself as “a carbon dioxide utilisation technology pioneer.”

Liquid Sun aims to develop synthetic feedstock production using low-temperature electrolysis at its Tampere plant. Its CEO Pasi Keinänen said: “To my knowledge, this is one of the first experiments in Finland, and perhaps even the Nordic region. By advancing this technology, we’re not just accelerating the commercial viability of e-fuels, we’re creating a pathway for Finland to establish itself as a global e-fuel powerhouse.”

Legislation

Finally, ICF’s *European Industrial SAF Policy* paper highlighted legislative reform as a further way to expediate the take-up of sustainable fuels: “The ReFuelEU Aviation obligation currently requires both physical SAF and environmental attributes (including ReFuelEU Aviation compliance tickets) to be mass-balance allocated to Union airports. While this allocation has some benefits, a system which allows obligated parties to trade some portion of the compliance tickets independently from the physical fuel (eg, through a book and claim mechanism), could facilitate market efficiency and price reductions. Such a system would encourage the construction of SAF facilities in regions where production is most cost-effective and reduce the market power of the incumbent companies that control the fossil fuel value chain.”

ICF sees opportunity in reforming how to invest the funds generated by the EU’s Emissions Trading Scheme: “An auction for multi-year allocations, in parallel to industry offtakes, would provide certainty to airlines and producers and would facilitate bankable agreements. Visibility on future increases to the volume, or feed-in mechanisms from allowances surrendered by aviation would provide further clarity.”

Refining the ReFuelEU Aviation mandate should be on the agenda, ICF believes: “The mandate includes five-year steps, each with abrupt increases. SAF is supplied through large infrastructure projects, which are slow to build and align to this profile. Smoothing the increases would limit the under/over-supply of SAF and the resulting market volatility.”

Although the ICF report called for reform, Alexander Kueper from Neste told *Air International* that the EU ReFuelEU Aviation regulation and the UK government’s SAF mandate “are good

NESTE MY
Sustainable Aviation Fuel

ABOVE:
Neste produces SAF at three refineries across Europe Neste

BELOW:
Sustainable aviation fuel amounts have more than quadrupled in the last three years Airbus

examples of steps in the right direction. Both have started with 2% [SAF] in 2025, with the EU increasing to 6% in 2030 and the UK to 10% by 2030. It's good to note that the availability of SAF to support the European mandates is there.

"Governments need to play a role in creating a market and demand for SAF. Supporting policies in the form of mandates, incentives or a combination of both are crucial to ramping-up SAF production and usage. These can create the demand certainty needed to attract investment into new production capacity."

What will the cost be?

Kueper believes demand certainty can "help airlines operating in a highly competitive environment mitigate the impact of using SAF. A broad as possible pool of sustainable feedstock will be needed to ramp up SAF production beyond current production technologies and raw materials."

According to the ICF paper, the SAF industry's development will redistribute energy production [and] create thousands of skilled jobs and create a meaningful commercial opportunity, with the value of the global SAF market forecast at nearly €15 billion by 2030.

Kueper said: "The cost is an important hurdle. In general, SAF currently costs two to three times the cost of fossil jet fuel, and with the cost of fuel constituting around 30% of the total cost of an airline, it is a challenge for airlines operating in a highly competitive environment to voluntarily start using SAF."

Wael Sawan, chief executive of Shell, told *The Times* in January 2025 that he thinks airlines will be slow to take up new fuels: "The reality is that SAF is more expensive and therefore unless there are mandates – obligations on either customers or airlines – it is difficult to see a penetration that is going to be massive."

Here is IATA's view on obligations: "A mandate is not IATA's preferred option for advancing the deployment of SAF, especially if it is not accompanied by positive measures. A mandate rarely delivers the optimal economic outcome, typically resulting in higher prices and thus diverting resources that could be deployed for other environmental investments."

Regarding the cost issue, Kueper told *Air International*: "Over time, as the industry scales up production, the cost of SAF could benefit from economies of scale. However, it remains a matter of comparing apples to oranges, as the cost of carbon and climate impact is currently not factored into the cost of fossil fuel. The real question is probably: 'What will the cost be if we don't start using SAF?'." **AI**

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Career carriers

Forecasts for the air cargo sector predict substantial growth in the next decade. As airlines strive to modernise their fleets, used airliners are being eagerly acquired and converted to meet the global airfreight demand, as **Alan Dron** explains

Brazil's AZUL operates EFW-converted Airbus A321Fs EFW

Not since the Berlin Airlift has cargo aircraft been so popular. The explosion in the growth of e-commerce means that freighters are in fashion – thanks to millions of packages being shipped around the world to meet online shoppers' appetites, combined with longer-standing factors such as the growing global movement of fresh fruit and flowers to keep northern hemisphere supermarket shelves stacked with exotica even in the depths of winter.

Freight volumes took off during the early days of the pandemic, when vast quantities of personal protection equipment and vaccines were being ferried internationally. That spike disappeared, but the long-term prospects for growth in the cargo market remain strong.

IATA's monthly air cargo figures have been showing a positive trend for well over a year. In December 2024, for example, air cargo demand continued its upward trajectory, with global cargo tonne kilometres (CTK) rising 6.1 per cent year-over-year (YoY), marking 17 consecutive months of growth.

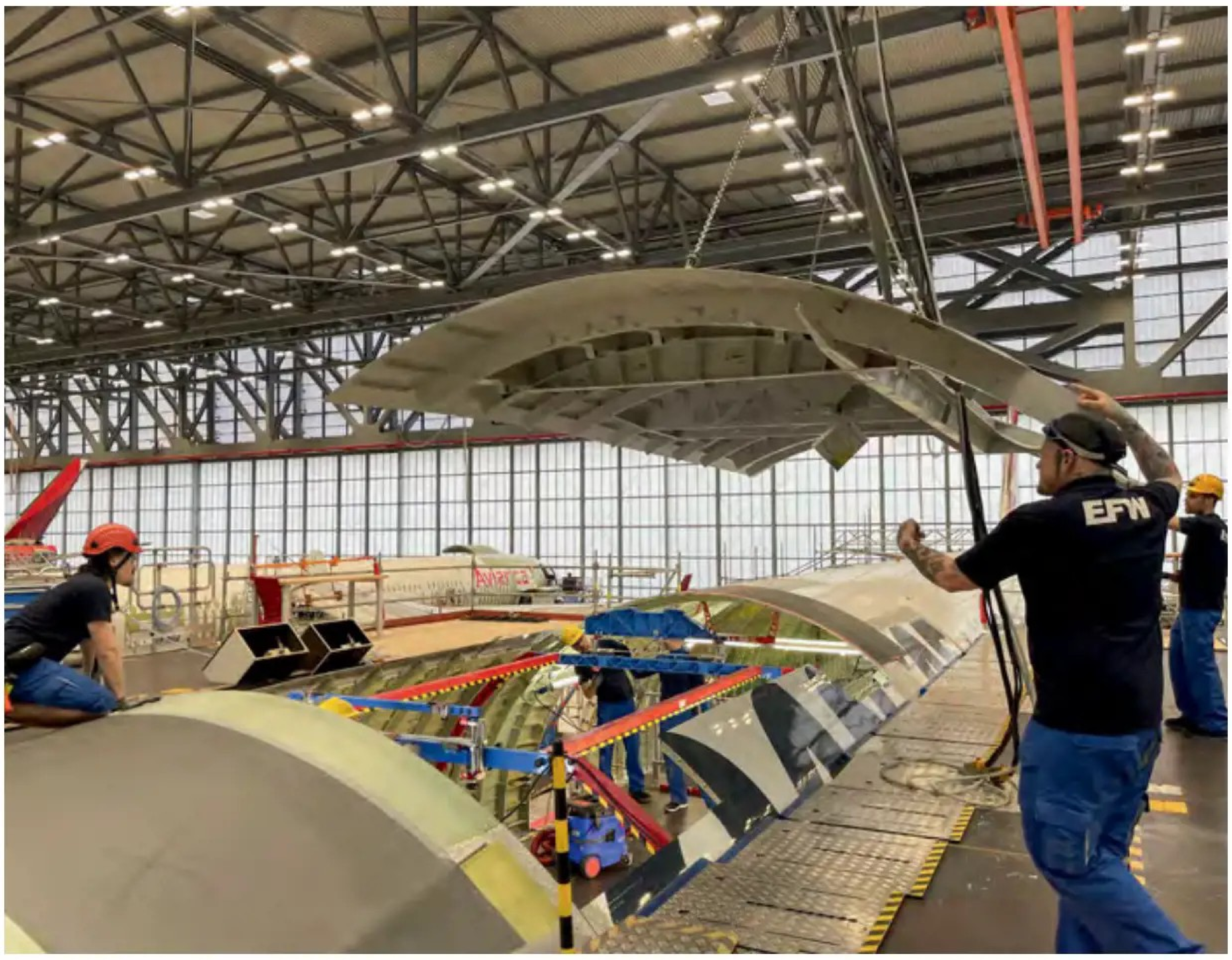
Full-year 2024 figures show that industry-wide CTK exceeded 2023 levels by 11.3 per cent, setting a new record beyond 2021's volumes.

The extreme circumstances of the pandemic, which saw underfloor cargo on passenger flights plummet as airlines grounded most of their fleets, led to an explosion in the conversion of older airliners to freighters (often referred to as P2F – passenger-to-freighter aircraft). This was particularly the case with Boeing's 737-800, whose cargo capacity of up to 23.9 tonnes was a useful increase over the previous-generation 737-300F's maximum load of 18 tonnes.

Conversion lines for the 737-800 sprang up worldwide, whether undertaken by Boeing itself (as 737-800BCFs,

RIGHT:
This Airbus A330-300P2F shows the amount of work undertaken by specialist conversion house EFW to create a freighter from a former passenger aircraft EFW

BELOW:
Conversion work under way at EFW's facility in Dresden EFW



or Boeing Converted Freighters) or by independent conversion houses.

The rapid increase in converted freighters coming off production lines led to predictions of a glut of aircraft.

Similarly, there has been an uptick in conversions of first-generation Airbus A320 and A321s.

Boeing and Airbus have been producing or preparing to produce new-build dedicated freighters, such as the 767F, 777F and the forthcoming A350F.

What is today's supply-and-demand situation?

"Commercial airplane demand remains strong across global markets, as operators continue to invest in more fuel-efficient, capable airplanes," said a Boeing spokesperson.

"The freight market is coming off an exceptionally strong year, with 2024 traffic up more than four times the annual average over the past 20 years (11% vs 2.6%). Strong traffic demand

has been boosted by e-commerce, especially the emergence of new direct-to-consumer models over the past two years. With our most recent long-term forecast, we project:

- the global air cargo fleet will rise to 3,900 aircraft by 2043, a two-thirds increase from 2,340 freighters in 2023,
- the large widebody freighter fleet will nearly double due to demand in high-growth Asian markets
- and nearly half of production and conversion deliveries will replace retiring freighters with more capable and fuel-efficient models; due to recent market needs, many older jets remain in service."

Boeing's latest 20-year forecast sees demand for 2,470 freighters, of which 1,530 will be conversions from passenger aircraft while 940 will be new-builds. Of the total, 970 will be narrowbodies, 880 mid-size widebodies and 620 will be large widebodies.

"Currently the world freighter fleet is around 2,220 aircraft. With 2,470 freighter deliveries in the next 20 years; and the retirement of 1,330 older, less fuel-efficient ones, by 2043, the world freighter fleet will reach 3,360 aircraft."

Boeing performs 737-800BCF conversions at various locations worldwide. "Conversion capacity is influenced by several factors, including the business environment and market demand," said the spokesperson. "We strive to maintain the right number of positions to satisfy market demand and support short-term business while also preparing for future growth as outlined in our long-term commercial market outlook.

"The Boeing Converted Freighter Program has also expanded the pool of 737-800 passenger aircraft that can be converted. Although nearly all Boeing 737-800 passenger aircraft are theoretically candidates for BCF conversion feedstock, certain aircraft require additional engineering prior to induction. We launched a feedstock expansion programme last year that has made a larger number of aircraft eligible for immediate induction.

"The global air cargo market is strong today, exceeding pre-pandemic levels, and we forecast it will continue to grow by an average of four per cent per year through 2043."

Boeing notes that e-commerce cargo is becoming more dense, with pallets weighing significantly more and some freighters out of Asia are operating near or at maximum structural payload. "This reinforces the need for large widebody freighters with great payload capability and high design densities. The 777 Freighter and 777-8 Freighter are perfectly suited for this."

The 777F has a cargo capacity of 103 tonnes, while its new competitor, the Airbus A350F, has a maximum payload of 111 tonnes. Boeing's new 777-8F freighter will leapfrog this figure, with a maximum payload of 118 tonnes. ➔

ABOVE:
The Boeing 767 has had a new lease of life as a freighter, but the production line will close in 2027 Alan Dron

BELOW:
Like most freighter conversions, the Airbus A320P2F uses first-generation aircraft that have reached the end of their life as passenger versions Airbus

Cargo renaissance

Meanwhile, recent years have seen an unexpected revival of the previous-generation 767-300F as a new-build freighter, although Boeing plans to halt production in 2027.

EFW, a joint venture between the European manufacturer and ST Engineering of Singapore, currently converts Airbus aircraft to freighters. The company has a major conversion centre in Dresden, Germany, handling A320, A321, A330-200 and A330-300 models. Over the past 30 years, it has converted more than 250 aircraft. EFW also has conversion lines in China.

EFW reported: "As the only conversion company with access to OEM data directly from Airbus, we offer hassle-free conversions designed and supported across the entire life-cycle of the aircraft. We are a design organisation and STC holder for all new-generation Airbus freighter conversion programmes, meaning we can undertake the entire conversion process, including airworthiness management (CAMO) and customer support when the aircraft is in service."

EFW's narrowbody conversions, the A320P2F and A321P2F, straddle the 737-800's payload at 21.9 tonnes and 27.9 tonnes, respectively.

Manufacturers and conversion houses make the point that conversion of passenger aircraft to freighters extends the aircraft's life: Airbus notes that the average age for a freighter is 25 years. They usually continue in service beyond 30 years – more than most passenger aircraft.

Meanwhile, Airbus is gearing up for the service introduction of the new-generation A350F.

An Airbus spokesperson said: "Our production sites have begun work on producing the first parts for the A350F." Engine pylons and tools are under production, while the company's A350 final assembly line in Toulouse, France, is preparing to incorporate freighter versions.

As of January 2025, Airbus had 63 A350Fs on order from ten customers.

Airbus sees Asia-Pacific and the US as strong markets; like Boeing, it views e-commerce as a significant driver of the freight sector.

While it accepts that overcapacity in the marketplace does occur, it tends to occur in cycles. "Currently, we don't see too much overcapacity in the market; we see that the overall trend is up.

"There's plenty of room for new capacity to enter the market as we see several older aircraft models being in service representing a significant number of ageing fleets.

"There are over 130 large freighters aged over 30 years, so a big replacement market exists. Combined with a healthy forecasted air cargo demand, we're confident about new capacity entering the market."

Independent conversion houses take a more cautious view of prospects. US-based Aeronautical Engineers (AEI) reported that the current market is continuing the general slowdown seen in 2019, which was interrupted by the spike in business caused by the pandemic. If anything, said Robert Convey, AEI's senior vice-president of sales and marketing, the number of unsold freighters – around 100 – currently sitting on the ground meant that the market was relatively slow at present.

To make matters worse, many of those aircraft have had their engines removed by their owners and sold, taking advantage of the high prices airlines are prepared to pay for replacement powerplants. Spare engines are at a premium, given the long hold-ups at MRO specialists suffering from supply chain and staff shortages, which result in engine overhauls taking much longer than normal.

That means anyone interested in buying one of the grounded aircraft may be deterred by the additional problem of finding replacement engines.

"The glut arrived, unpacked its suitcase and it's not going anywhere soon," Convey said. The number of unsold aircraft was slowly diminishing, but the market outlook for narrowbodies – AEI's bread and butter – "is fairly quiet. On the narrowbody side, I would say we have one or two quiet years, then it will pick up."

He added that recovery would only fully occur once the feedstock for conversions, namely 737-800s, became available again.

At present, Boeing's production problems – notably, the FAA-imposed production cap of 38 737 MAXs a month until the US regulator is satisfied Boeing has its house in order following the blow-out of an Alaska Airlines door panel in flight in January 2024 – mean many airlines are holding on to their older 737-800s for longer than anticipated.

"We can't get to a full recovery until the 737-800s start coming out of [passenger] operation." AEI is developing a cargo modification for the larger 737-900 but is being hampered by the ongoing problems at Boeing, which are leading to management paralysis and mean the Seattle airframer "can't make the simplest of decisions" to help AEI progress its project.

However, medium-sized widebodies, such as A330s and 777s, are a different story: "I think we're going to see a lot of activity for these widebody platforms over the next decade."

BELOW:
The Airbus A321F is an increasingly popular conversion subject due to its 24 container positions and 28-tonne payload capacity Alan Dron

SalamAir
CARGO

Carrying the future

New freighters continue to be developed by manufacturers and specialist conversion houses.

Embraer has just received approval from the FAA, EASA and the Brazilian regulator for its E190F, a conversion of the E190 E1, examples of which are starting to exit passenger service. With a payload of 10.7 tonnes, Embraer sees it fitting between the turboprop market and older-generation narrowbody jets such as the 737 and A320. A larger E195F is also planned, able to carry 12.3 tonnes.

The first E190F has been completed and delivered to Regional One, a US lessor and partner. The second example (also for Regional One) is planned for completion in the first half of 2025. The US company has taken up to ten conversion slots.

Embraer says the E-Jet freighters have upwards of 40% more volume capacity and three times the range of large cargo turboprops. They enable new destinations and longer distances while having up to 30 per cent lower operating costs than larger narrowbodies.

Meanwhile, Swedish engineering specialist Täby Air Maintenance (TAM) is in the final stages of achieving certification for a freighter version of the Saab 2000 regional turboprop.

The Saab 2000 was the successor to the widely sold Saab 340. Its capacity was around 50 passengers, compared with the 340's 34-seat configuration. The Saab 2000 was a niche product: only 59 were built, compared with 459 Saab 340s.

TAM, based at Örebro Airport, has been working on a cargo version of the Saab 2000 for several years, and completed a prototype freighter in early 2023.

TAM CEO Pär Gulle said in January that the company was awaiting the return of documents from EASA. Once EASA

BELOW:
Embraer's first E190F will enter service this year
Credit Embraer

OPPOSITE:
Sweden's Täby Air Maintenance is close to certification of its Saab 2000 freighter conversion
Credit Täby Air Maintenance

E-FREIGHTER
E190F
RegionalOne
986
N986TA

certification is completed, the next stage will be to gain FAA approval.

Once certificated, the freighter will have a capacity of 6.5 tons. Gulle describes the 2000F as a niche aircraft with "quite impressive performance in terms of speed, range, climb rate and ability to handle crosswinds."

Like the earlier Saab 340, the Saab 2000 is a solidly built aircraft, well suited to the rough-and-tumble of freight hauling, especially in remote areas.

Around half of the 59 Saab 2000s built are in military service and unlikely to be available for conversion. But of the remainder, Gulle said, perhaps "a quarter to one-third" might be considered for a switch to the cargo role.

TAM has secured Jetstream Aviation Capital, a Florida-based launch customer that is acquiring two aircraft.

Another specialist US conversion house, Pemco, aligns with AEI's views on the 737-800 market. Mike Andrews, director of commercial conversions at Pemco Conversions, said: "Since COVID, the narrow-body freighter market has exploded.

"There was a massive push to convert many 737-800s and get them into the market. Since then, the market has levelled off. Or, should I say, it corrected itself. And the last few conversions have to find a home. This will come from retirements or start-up companies."

Pemco is taking a slightly different path when it comes to producing conversions. "Our main focus is on the 737-700 freighter and the 737-700FC," Andrews said. "We know this is a niche market, but we have chosen this lane to provide our customers with an option to expand flexibility in the cargo space."

In recent years, Pemco has produced a proprietary variant called the 737-700FC, or FlexCombi. This variant features a freight area occupying most of the main cabin deck and a small passenger section at the rear of the fuselage. A movable bulkhead enables the aircraft to accommodate either 12 or 24 passengers.

Launch customer for the type was small Bahrain-based cargo specialist Texel Air, whose cargoes can include racehorses; the seating area at the rear allows the company to carry grooms to look after the animals on flights.

"Several more airlines are interested in this variant," said Andrews, "and I hope we will be able to share those names in the near future.

"We are in the final stage of approval to add an additional role to configure this aircraft to a three pallet and 60-passenger configuration aircraft, which will make this the only 737 capable of converting into four configurations. This aircraft is truly flexible to meet the customer's needs."

Over the years, Pemco has converted more than 175 737s, "and 2025 is looking strong for us".

Although the company remains focused on 737s, it also converts A321-200s for 321 Precision Conversions. Pemco is owned by ATSG, which has a joint venture with Precision. "We feel this aircraft will be a big part of the freighter market in the future."

The size of A321 enables it to fill the role of the Boeing 757, which is now largely out of service, while also allowing it to expand into the 737-800 market. "This aircraft is performing well in the network and receiving positive performance reviews."

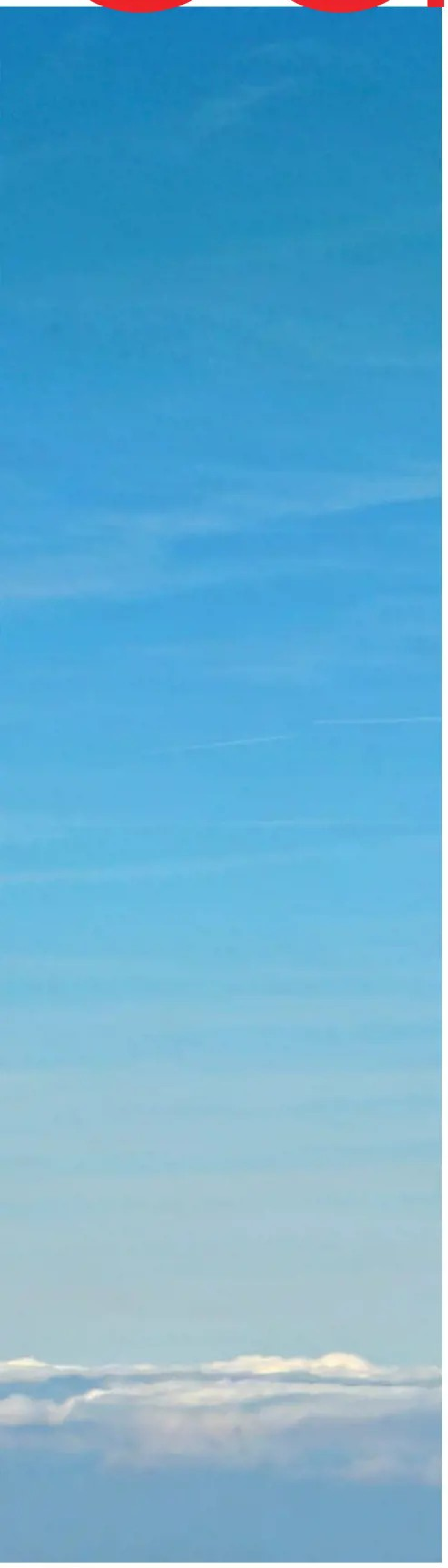
Boeing foresees many new (or converted) freighters over the next 20 years, many of which will be destined for small airlines in regions such as Asia-Pacific and Africa. Many airlines there operate decidedly elderly types. Even the hardiest freighters eventually run out of flying hours, and those small carriers will have to find replacements or go out of business.

The two-generations-old Boeing 737-300F and -400F are now showing their age, so what options do these airlines have? A 'new' conversion of a 737-800 can cost as much as $25m – far too much for small companies operating on thin margins with a limited number of aircraft. Hauling freight into remote secondary airports will remain important in many countries, but it is still uncertain what type of aircraft will fulfil that role a decade or more from now. **AI**

Rugg

The Britten-Norman Islander is one of the most successful aircraft in British aviation history. Ideal for short-haul high-frequency operations and commuter flights, it's a role that it looks set to fulfil for many years to come All images via Britten-Norman unless stated

ed, reliable, and relevant



In the last few years Britten-Norman has been quietly undergoing a restructuring process and new investment, relocating its manufacturing facilities and now ramping up Islander production. Chief executive William Hynett OBE, spoke to **Glenn Sands** about what lies ahead

William Hynett exudes a confident calm when discussing Britten-Norman, the company he has been with since 2003. This likely reflects his faith in Britten-Norman's products, particularly the Islander. It's an aircraft that is in use daily, in some cases in the most inhospitable environments. There has been a longstanding need for such a platform, and now, thanks in part to new long-term investment from Northern Ireland-based Beechlands Enterprises, the Islander is poised for significant advancements.

Hyett explained to *Air International* why the company has remained somewhat under the radar in terms of production and orders in recent years. "We effectively reinvented the company in 2000 and deliberately adopted a low-volume manufacturing model," he says. "A primary reason for this was our significant work for the Ministry of Defence, which operated in Iraq, Afghanistan, and other locations. For a small business like ours, it was an enormous amount of work, necessitating choices about prioritisation at that time. We always wanted to keep in the manufacturing game, but building Islanders is vital to us. Building new aircraft is capital intensive; therefore, our market's customer base for people with the money upfront to buy aircraft was relatively low. Because of this, our

CLOCKWISE FROM ABOVE:

New investment has allowed Britten-Norman to complete its aircraft manufacturing repatriation programme and given the OEM the opportunity to focus on crucial international aftermarket operations

In the past two decades, Britten-Norman has been heavily committed to supporting the MOD's use of its Islander and Defender fleet on surveillance and intelligence-gathering operations at home and abroad Cpl Rich Denton/MOD Crown Copyright

William Hynett OBE, chief executive at Britten-Norman

balance was really defence and a small bit of manufacturing.

"In about 2017, we had a strategic review and asked ourselves, 'What are we trying to do?' One of the reasons we decided that manufacturing had to be a low volume was partly about the customer base but equally about the supply chain. We were finding building aircraft in Romania just wasn't efficient for us."

Islander airframes were assembled as kits under subcontract in Romania by Romaero in Bucharest before being delivered to the UK for final assembly, an arrangement that began in the 1960s and saw more than 500 of the type manufactured this way. Hynett continues: "Romania was good at making aircraft, but they were not efficient at making them, and the reliability of supply was low. Generally, they would prioritise higher paid volume work from OEMs such as Airbus, Boeing and IAI, and they would focus on our production line when they were effectively in a lull. It meant we had to take aircraft when Romania could make them rather than when we needed them. It presented several challenges when it came to customers because, generally, they were making quite late purchases and wanted something quickly. We were not able to meet that demand."

In 2009, the company decided to change its manufacturing model from building in Romania and finishing the aircraft at the company's Bembridge site on the Isle of Wight to building component parts in Romania, assembling them in Bembridge, customising them to the required specifications, and then delivering the aircraft to the customer. This revised approach worked adequately for about ten years. Hynett continues: "In 2017, when we were looking at what we were going to do in the next five years or so, we realised that we needed to get better control of the timing of deliveries of aircraft and increase volume.

"We noticed that the average age of the fleet was getting higher and a lot of our customers were dealing with 40-year-old-plus aircraft, which became economically less and less viable. So, we needed to do two things: one was to seek investment and the other was to think about how we manufacture our products. The decision was taken to repatriate manufacturing and then also go out and seek additional investment," Hynett says. "By the time we had organised the business, through its shareholding, to look for investment, it was about February 2020, so our search lasted for about three weeks before we started dealing with international lockdowns due to COVID-19. So, the next few years were all about the company's survival.

"It was a challenging market for us, and a lot of our customers were struggling. We had not raised our capital, so we were left in a difficult position then. Adding to this was that we had started an exit from Romania but hadn't completed it. Lockdowns had called a halt to it."

For Britten-Norman, this meant that bringing the necessary tooling and jigs to set up production back in the UK was not restarted until late 2023. The company had announced to the market its intention to return to UK-based production, but the reality was, as Hynett explains, the OEM still required further capital to achieve this fully. At the time, additional capital from the current shareholders was not an option.

He continues: "We went through several iterations to try and find that investment, which ultimately landed in October 2024; an entity with a high net-worth backing and an interest in UK manufacturing, with no previous experience of it, but a keen interest in it. It's someone who basically saw the value in the product and the people of Britten-Norman. It effectively became a takeover of the business at that point because they bought 100% of the shareholding."

Air International asked Hynett where the reorganisation currently puts the company.

"Although we were about 90% complete on the repatriation phase, there was a critical 10% we hadn't done, which made building aircraft hard. We've got to go through a management change issue because we've been manufacturing in Romania for such a long time. Although it's always been 'our' manufacturing process that is effectively loaned, they are effectively sub-contractor labourers in Romania. Under the regulations, such a significant location change requires a lot of engagement from the CAA and investment in plant machinery and people, with everything that needs to be established in the UK. This has been taking place since October 2024.

"The final jigs required for manufacturing arrived in December, and some additional machinery is scheduled to arrive this month. Most importantly, obtaining the necessary mill runs of materials is challenging within the current international supply chain situation."

Ensuring the right gauges for metal materials is critically important for aircraft production. Organising the correct weights has taken longer than anticipated, but Hynett is keen to point out that the supply chain issues have been resolved. "We've organised this new set-up to remove some of the issues we have had at the Bembridge site. It's widely known that things have not always been simple there, and we do not have airfield access, so since 2010 it's effectively been a component site rather than a flying site, and this will continue for the time being. We will effectively replicate what we were doing in Romania at Bembridge, and what we were doing there, we will now do at Daedalus Airfield, Lee-on-the-Solent."

With an order book currently at 29 aircraft, for what is still a small company in terms of aircraft manufacture, is an ambitious target but one Hynett is very confident Britten-Norman can accomplish. "Twenty-nine is our target, but the immediate short-term target is the first Bembridge-built aircraft, which will be the first in many decades.

"We're going through the process with the CAA now to get everything spot-on. This first aircraft is a batch of six, for which we've already built detailed parts for. These first six will take us through financial years 2026 and into March 2027, and thereafter, it's a ramp-up in production."

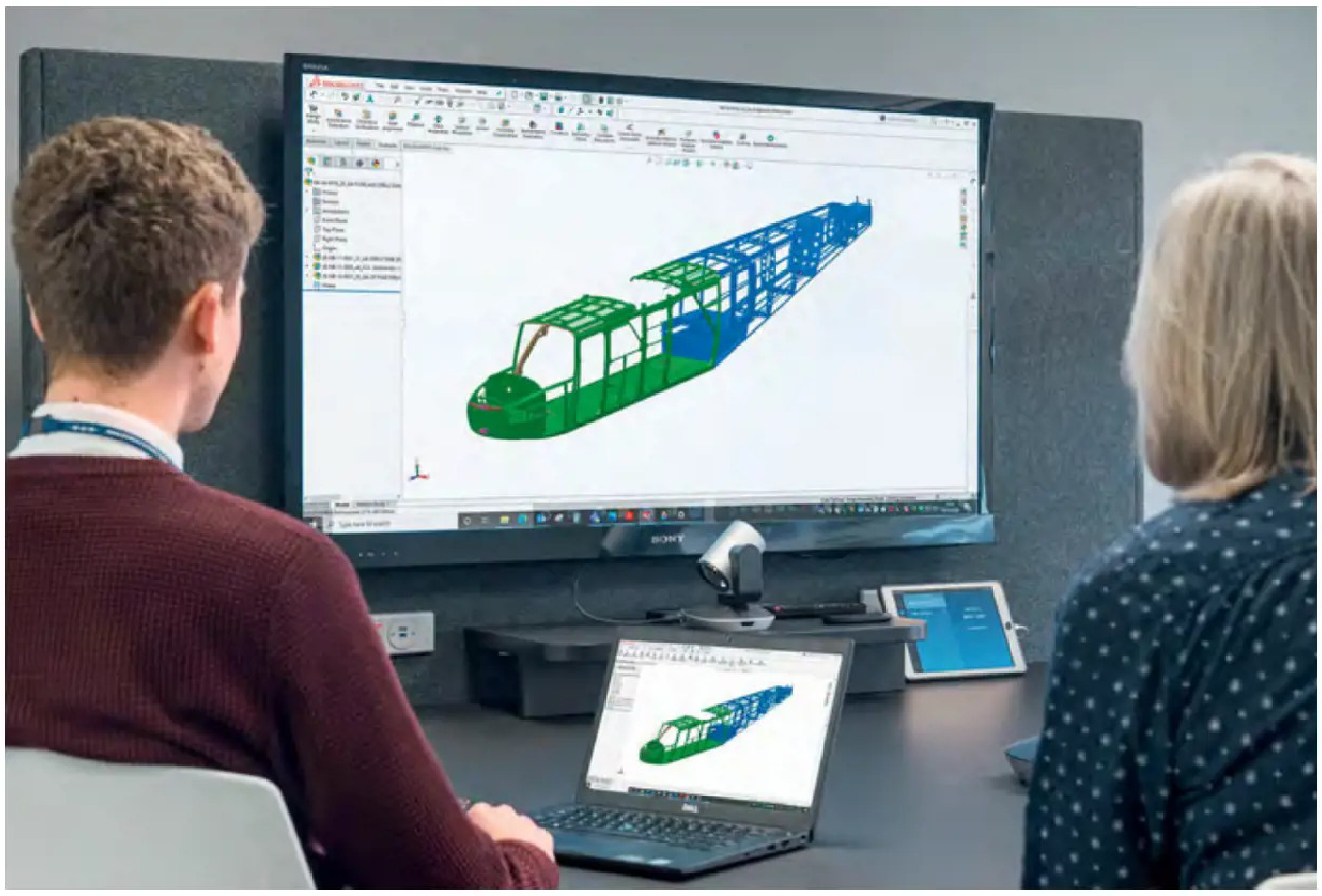
Asked what the annual target is, Hynett replies: "It will be initially eight aircraft per year, which, to put it into context: on average, we've built two aircraft per year over the last 20 years. So, we're quadrupling manufacturing. Manufacturing eight aircraft per year for the foreseeable future is a realistic baseline for the company, and using the investment gives the flexibility to scale that up should there be a demand."

What does the market demand look like within this sector? Hynett explains: ➔

CLOCKWISE FROM RIGHT:
The Islander's construction allows for significant modifications to the basic airframe. Britten-Norman's research and development team based at its Southampton office site

New Islanders have a Garmin G600 TXi glass cockpit as standard

Bringing construction back to the UK has eased the logistics chain and will allow Britten-Norman to increase production to a baseline of eight aircraft per year in the years ahead

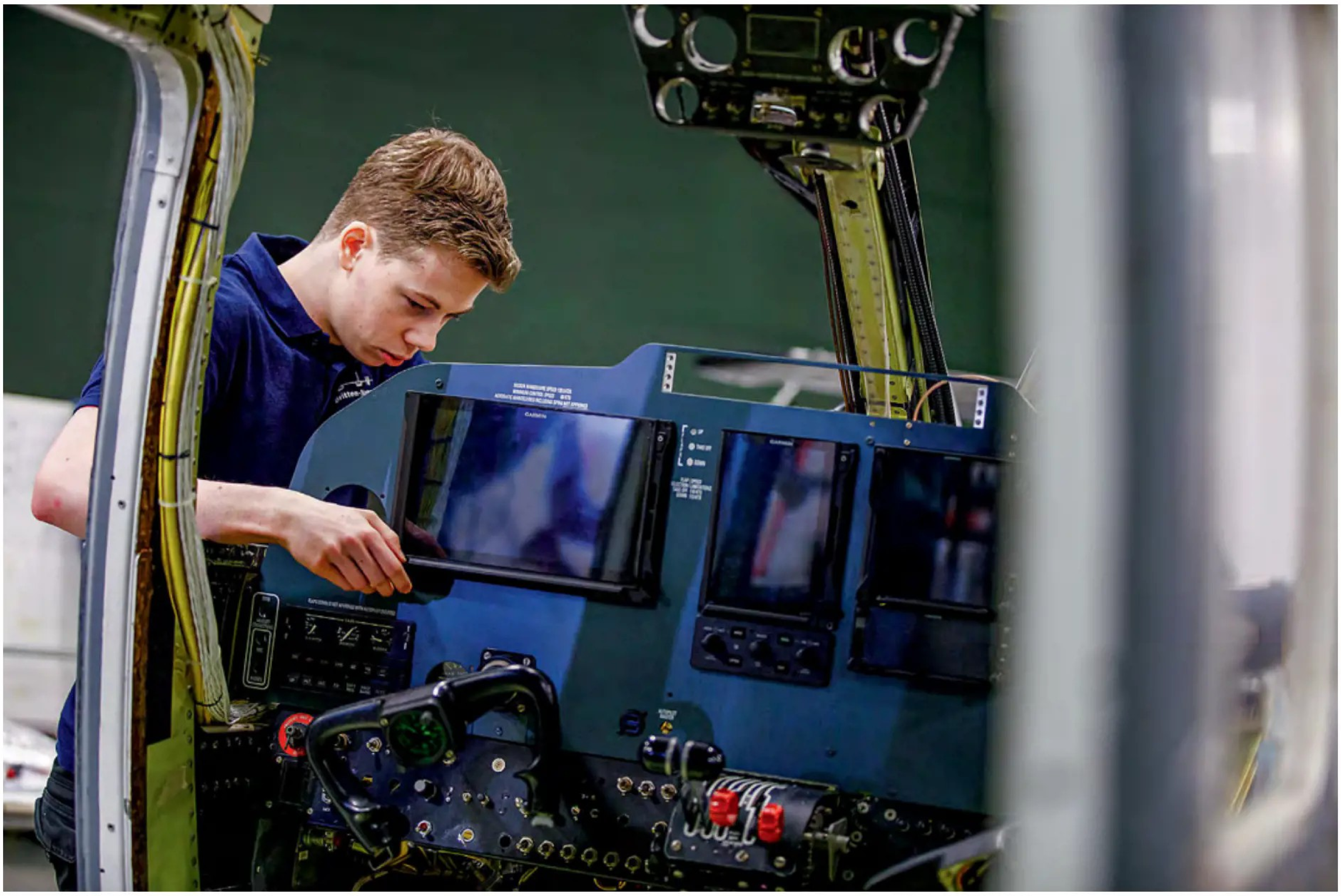


"I think market demand is going to be based on a number of variables, but there's a strong conventional piston market out there. There's a smaller but very important turboprop market still present. And, in particular, as we move towards SAF fuel on the turboprop, that becomes one of the greener solutions in manufacturing. Also, there's the publicity about what will happen with hydrogen.

"People are aware of our involvement with Project Fresson alongside Cranfield Aerospace, but its viability remains uncertain since it is not our product. It belongs to Cranfield, and whether they will market that powertrain or pursue the STC [supplemental type certificate] themselves, we will support them in that endeavour. If not, we will assess the market and remain open-minded about whether it will ultimately shift towards electric, hydrogen, or SAF. We don't want to pin our colours to a specific mast because that's not our role – it is air-framing; we are not powerplant specialists. We utilise other powerplants available to create the best product possible for the market."

Hynett explains that when something viable and appropriate is available to the market that's right for the company and is easy to install on the aircraft as a powerplant, it will be looked at. "It has to give the us the kind of endurance that typical customers – it won't be them all – want to achieve, and it's got to have the right passenger payload. If it can't accomplish those three things, it's simply not a viable alternative for us.

"Many of our customers require seven to eight passengers to make it a sustainable, profitable operation, and need a minimum of an hour's endurance plus reserves. So, any green product that



gives us those sorts of parameters will be of interest to us."

The aviation niche that the Islander has created for itself in the sector through the decades has seen it operate in some of the harshest climates across many of the remotest regions in the world, and according to Hynett, this shows no signs of tailing off. "What many of our customers are interested in is that we are forward thinking enough to have a development pathway for the product. So, the message we have for the market is that, yes, we are open to options for the future that keep the Islander relevant in the marketplace.

"We have a research and development cell that is looking at those sorts of opportunities to pick the right path for the business. But, in terms of our core credentials, it's relatively simple – it's an aircraft with rugged reliability." Hynett continues: "They want short-field performance, reliability and affordability. That is often the case within aerospace; most people don't want to take a punt on something new and unproven; they want an aircraft that has proven itself over a long period of time, and the Islander fits that bill."

Many of the company's customers are realising that their fleet is getting old, so Brittain-Norman is helping them with renewal programmes. Where requested, it has integrated upgrades to the Islander, particularly in the cockpit, with the latest generation of Garmin avionics suites and displays available to the aircraft.

"A lot of our customers are VFR operations on short sectors; they don't necessarily need a full-glass cockpit, but it helps, and the information it can bring, particularly with things like the engine instrumentation system from Garmin, gives you a lot of parameters around what these are doing during a flight. It has good maintenance data, which is very helpful, assists planners with their maintenance activities better, and helps them understand when things go awry," says Hynett.

It's also about obsolescence management since many older Islanders have gauges that went out of production several years ago. When the customers come to renew them, Britten-Norman offers the option to go for analogue instrumentation or to

install a relatively reasonably priced Garmin suite.

New build Islanders will receive the Garmin suite, essentially a glass cockpit based on the G600, as standard. "In the retrofit market, customers sometimes prefer not to over-invest, so we offer a lower-cost option that utilises multiple GI 275s," Hynett explains. "These are the Garmin six-pack replacement instruments used in both engine setups and configurations for the altitude indicator (AI) and horizontal situation indicator (HSI). This solution effectively 'spruces up' a dated cockpit without requiring significant investment in an older product."

It's a method that works as the company announced several significant orders in 2024, and Hynett mentions that other discussions are taking place later in the year. Asked about the recently confirmed orders, such as those in the Falkland Islands and Guyana, he states: "Guyana is an interesting territory, and there are a lot of hotspots around the world that are similar, where it's very much alive as a market, not just to us but for other aircraft manufacturers. Guyana has a lot of minerals and resources, and a need to get into the backcountry, which is why the Islander is a very suitable product for that. Operators want the flexibility to have an aircraft capable of either having a full seat configuration and taking people out to these remote locations in the jungle or just taking the seats out and putting a piece of heavy machinery in the back instead.

"Of course, flying over what is quite an inhospitable terrain with the jungle canopy and Amazon-type terrain, is very tough. If you had an engine failure you would want to know your one good engine is still going to get you back, and this is, I believe, a competitive advantage for us, having the safety factor of two engines on the Islander."

Asking Hynett what he believes secured the 2024 Falkland Islands

Government Aviation Service (FIGAS) order for four BN2B-26 Islanders for $9.75m, he responds: “The Falklands are slightly different in some ways. You need the twin-engine safety again in such remote territory. It’s exceptionally tough terrain, comparable to the Orkneys and Shetlands, perhaps even harder. However, the Islanders there are still operating off grass strips; you require an aircraft that can withstand significant wear and tear during operations, as that is the environment of the Falklands.”

Looking again to the future, Hynett is keen to point out the platform slots into several sectors, including the drive towards sustainable aviation. “I believe the Islander is a perfect fit for Project Fresson because the entire concept of the project aims to retrofit and forward-fit new hybrid-electric power plants. The beauty of the Islander, by a fortunate coincidence, lies in the fact that many of the aircraft were built with military-style hardpoints on the wings, which, although not used, are nevertheless part of the aircraft’s DNA. This design allows for the installation of hydrogen pods instead of traditional fuel tanks or munitions in the wings. Therefore, rather than requiring a significantly invasive modification to the wings or utilising the cabin space, as some other OEMs are doing, the Islander permits external storage, making it an ideal candidate for early hydrogen adoption. However, I believe that other technologies will emerge as well.

“The feedback we have received about the Islander, particularly from the surveillance sector, highlights its operational capabilities. It can fly in a long, slow, loiter pattern, and you can cut holes in the airframe to install surveillance equipment since it is constructed from a ‘good old aluminium

CLOCKWISE FROM BELOW:

Manufacturing in the next few years for Britten-Norman will be focussed primarily on the unleaded piston version of the Islander, with around 20% of the aircraft being delivered as turboprops

Islanders serve as a vital lifeline for both civilian and commercial sub-regional operations in some of the world’s most remote locations

A plan to modernise the Falkland Islands Government Aviation Service saw an order for four new BN2B-26 Islanders to replace older Islanders that have been operating in the challenging South Atlantic conditions

structure' rather than fibreglass. Additionally, it is unpressurised, making it easy to configure for specialist equipment, whether a hydrogen tank or intelligence-gathering tools. Its practical design facilitates implementation."

Ask any operator who flies Islanders about Britten-Norman and one thing they agree on is that the relationship between them and the OEM is extremely good. Hynett believes his company can do even better: "There's a strong focus on customers within the company and I believe that accepting one's shortcomings is essential for survival in this industry. We must understand what we do well and what we do not. It's fair to say that while many individual customers have greatly benefited from the personalised approach we've taken in supporting them, others may feel the support hasn't been adequate. This issue has primarily arisen from our capital constraints. Supporting a fleet of aircraft that is literally spread across the globe presents challenges due to complex logistics. One must grasp the scale involved, particularly concerning the spare parts that need to be available, especially for an aircraft that has been in existence for over 50 years. Getting that right creates its own challenges."

This is another one of the key factors behind the October investment. Hynett emphasises this isn't just an investment in newly built Islanders and the future: "It is an investment in the aftermarket for our customers so that we can follow what will be a positive attitude to them. Making sure that they've got what they need when they need it – that's a key part of why we sought the investment."

The five-year plan that Britten-Norman now has in place will see the focal point of 29 aircraft completed by 2029 and, thereafter, an expected baseline production rate of eight Islanders per year, with the ability to scale up if the market demands it. The Islander has a very secure development future within the sector. Hynett sums up the company's outlook for the aircraft by comparing development evolution to that of the car market. "If you think about cars and how they have evolved, there's a common pedigree through some of the brands with a major effort to update them so they're relevant to today's market. I think aircraft manufacturers must do the same thing effectively because customers' expectations are higher than 30-40 years ago. So, part of our mission will be to use the investment not just to get the baseline operation right but it's also able to invest in the product itself. I don't think it will be a wholesale change at this stage, but it will certainly be improvements to the Islander that make it relevant to today's market, and that's our key focus." **AI**

The UK New Medium Helicopter competition is nearing its conclusion, but a three-way tussle for up to 44 aircraft has effectively become a sole-source procurement of a much smaller number of helicopters, as **Jon Lake** explains

NMH decision

ABOVE:
The New Medium Helicopter was intended to replace RAF Pumas and a range of other helicopters, including the Cyprus-based Bell 412 Griffons of 84 Squadron
MOD/Crown Copyright

OPPOSITE:
A pair of AW149s pictured over the Yeovil factory in Somerset. Under the successive Westland, Agusta Westland and Leonardo banners, Yeovil is the 'Home of the British Helicopter'
All images via Leonardo Helicopters unless stated

draws close?

The NMH competition, launched in 2021, aimed to provide the UK's armed forces with a New Medium Helicopter (NMH).

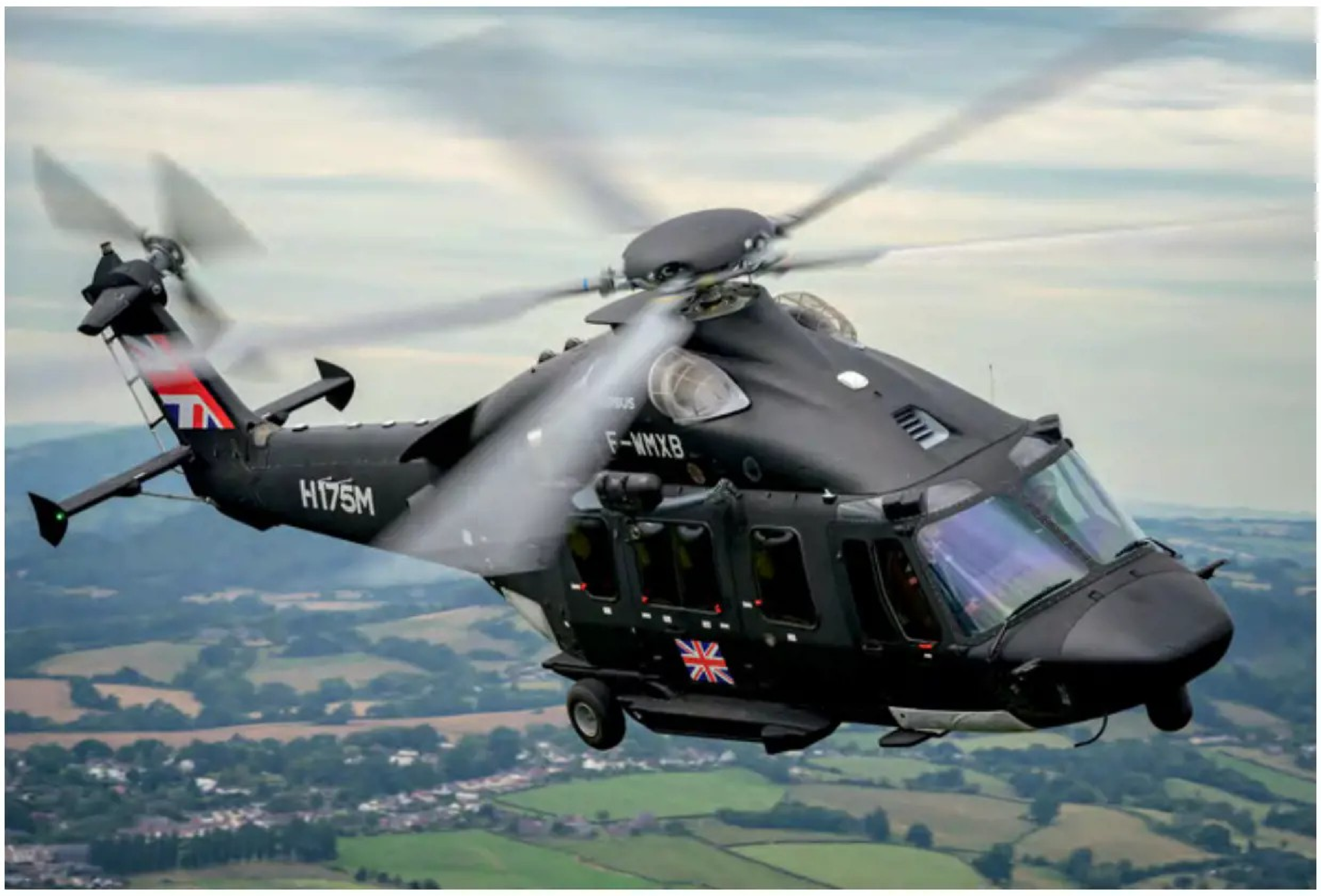
The requirement was officially revealed by Colonel Paul Morris, assistant head of plans, capability air manoeuvre, on February 23, 2021, during the Defence IQ virtual International Military Helicopter conference. Few details were disclosed, but it was said that potential options were being 'scoped' under the UK Rotary Wing Strategy.

The *Defence in a Competitive Age* Command paper was published on March 22, 2021, outlining the defence ministry's intention to invest in a new medium-lift helicopter during the mid-2020s. In the accompanying Defence and Security Industrial Strategy, it noted that the existing fleet of 23 Pumas, six Dauphins and six Bell 212/412s would be consolidated, replacing all types with a single successor helicopter, the NMH. This new helicopter was designed to be a "common medium-lift multirole helicopter, fitted for, but not with, specialist mission role equipment, and capable of operating in all environments to support defence tasks."

The NMH requirement was primarily intended to find a replacement for the RAF's 23 remaining Westland Aerospatiale Puma HC.Mk 2 helicopters, which were delivered (as HC.Mk 1s) on January 29, 1971, and began to equip No.33 Squadron at Odiham in Hampshire on June 14, 1971. The RAF procured a total of 55 aircraft and upgraded 24 of them to HC.Mk 2 standards between 2012 and 2014.

The Puma's out of service date had been set for March 31, 2025 as long ago as 2012, when they were upgraded. The HC.Mk 2 modifications included new Turbomeca Makila engines, engine controls, gearboxes and tail rotors, a digital autopilot, flight management system, an improved defensive aids suite and ballistic protection for cockpit and cabin – the Puma HC.Mk 2 was able to carry double the payload over three times the range of the original Puma HC.Mk 1.

The transfer of the RAF's 22 Merlin HC.Mk 3s and six HC.Mk 3As to the



ABOVE: ***The Airbus H175M was Airbus Helicopters' proposal for the NMH requirement and is a militarised version of the civil H175. It had the most spacious cabin among the three designs that reached the ITN phase***
Airbus Helicopters

RIGHT: ***The Lockheed Martin bid was for the Sikorsky S.70M, a Polish-built derivative of the S.70i 'International' Black Hawk. The Black Hawk received substantial support from some members of the user community***
Lockheed Martin

Royal Navy between 2012 and 2014 left the RAF Support Helicopter Force consisting of three squadrons of Boeing Chinooks and two Puma squadrons. Extending the service life of the Puma out to 2030 was considered and rejected, and replacing the type assumed a greater significance and importance.

As the requirement for a new medium-lift helicopter was formulated, the decision was taken that what emerged from the NMH programme would be a single modern, medium-lift support helicopter type that would address up to five separate rotary wing requirements. These included a replacement for the RAF's 23 Pumas, but also replacements for six Army Air Corps AS565 Dauphins used for special forces support, as well as three Army Air Corps Bell 212s (in Brunei) and three RAF Bell 412s (in Cyprus).

There was confusion regarding whether the government's social value yardstick would prioritise 'new' jobs (newly created jobs rather than existing jobs that were merely being sustained) or whether jobs in Cheshire and Gosport might be scored 'higher' than those in Yeovil.

It soon became clear that the Airbus Helicopters H175M, the Leonardo AW149 and the Sikorsky Black Hawk were the front-runners in the NMH competition.

The Airbus bid was based on H175M – a militarised variant of the civilian Airbus H175. Airbus described this as "a high-capability, low-risk solution with outstanding technical and safety specifications, already operating successfully in various demanding roles and environments."

Airbus said if the H175M was selected, it would be made and serviced in Britain by the so-called H175M Task Force, which included Airbus, Babcock, Boeing Defence UK, Pratt & Whitney Canada and Spirit AeroSystems. Design work would be performed in Belfast, and the aircraft would be 'made' at Broughton in North Wales, though whether this represented more than final assembly was never made clear.

Airbus insisted that selection of the H175M would create hundreds of jobs and act as a catalyst for strong export sales and said it would "help to drive competition and innovation in the UK helicopter industry".

The H175M shares many similarities with the Juno HT.Mk 1 (Airbus H135) and Jupiter HT.Mk 1 (Airbus H145) helicopters used in the MOD's Military Flying Training System and with the H145s recently purchased for the Brunei and Cyprus roles.

Leonardo's bid is based on the often misunderstood AW149. Although competitors frequently refer to it as part of the AW139 family, it is not a 'green-painted oil and gas helicopter', as they often suggest. Indeed, Leonardo rejects any implication of a relationship between

PZL Mielec
A Sikorsky Company
SIKORSKY
036
SP-YVA

the two, insisting that the AW149 "began life as an all-new, blank sheet of paper, military design".

The AW149 is a completely redesigned and all-military helicopter with formidable crashworthiness and survivability features, excellent performance and handling characteristics. Leonardo is the UK's only helicopter manufacturer and currently employs 3,300 people. Leonardo Helicopters is an 'end-to-end' helicopter company, with capabilities from design and build, through assembly, integration and test, and certification through to support, providing the UK with sovereign freedom of action and operational independence. The company has supported urgent operational requirements (UORs) for modifications and upgrades to its own products and for non-Leonardo helicopters including the Chinook and Puma.

The majority of AW149's structural design was undertaken at Yeovil, and the company has already made a multi-million-pound investment in a new AW149 manufacturing facility at 'the Home of British Helicopters in Yeovil'. Jigs, tools and fixtures are already in place, and Yeovil engineers have been training in Italy. This all means that Leonardo can deliver a military off-the-shelf aircraft from Yeovil within 12-14 months of contract signature.

As part of its bid, Leonardo has established a supply chain of more than 70 UK companies and has committed to undertaking at least 60% of total AW149 production in the UK. However, Leonardo says that 40% of work on the AW149 would be placed with suppliers located in ten per cent of the most deprived local authorities in England, as defined by the UK government!

The AW149's run-dry transmission allows 50 minutes of continued flight even after suffering total oil loss. The H175M and AW149 both have large cabin volumes and can accommodate 16 troops, compared with the Black Hawk's 12.

Lockheed Martin UK presented the S-70M Black Hawk, which is based on the S-70i 'International' Black Hawk manufactured by Sikorsky subsidiary PZL Mielec in Poland. Lockheed Martin UK CEO Paul Livingston said approximately 40% of the overall value of the NMH programme would be sourced from within the UK if the Black Hawk is selected, and noted that having an operational 'hot' Black Hawk production line in Poland would enable Lockheed Martin to "pivot more quickly to establish operations in the UK".

The Team Black Hawk launched by Lockheed Martin UK in September

ABOVE:
An AW149 development aircraft firing flares during the type's flight test campaign. This example has the extended radar nose

OPPOSITE:
Some have criticised the limited arc of fire available from the crew-served machine guns in the forward windows of the '149, which force the gunner to lean out into the slipstream

2023 included a range of UK partners, including Gosport-based StandardAero, which was to undertake the final assembly. Other partners included Ascent Flight Training &and CAE at RAF Benson, Chelton in Marlow, Curtiss-Wright in Christchurch, C3IA Solutions in Poole, Inzpire in Lincoln, Martin-Baker in Denham and Nova Systems in Filton.

Lockheed said the selection of the S.70M would allow the UK to participate in modernising the nearly 4,000 Black Hawk helicopters sold worldwide and in developing and producing the company's next-generation rotorcraft solutions.

The Black Hawk enjoys strong support within certain segments of the user community, thanks to the formidable reputation and track record of the US Black Hawk. However, the variant available was not an FMS UH-60 and did not provide the same level of commonality or interoperability advantages.

The mature and combat-proven Black Hawk has more integrated weapons than its competitors, and its tailwheel configuration provides advantages in certain situations (although the H175M and AW149 have more compact dimensions when landing on constrained helipads).

Three additional bidders were eliminated during the Contract Notice and Dynamic Pre-Qualification Questionnaire phase, which was issued in May 2022 with a deadline of June 20 that year and the decision announced in the November. Boeing had offered a version of the MH-139 Grey Wolf, while Bell submitted a bid based on the Model 525 Relentless. There was also a bid from AceHawk Aerospace, based on upgraded ex-US Army UH-60A airframes set for conversion in Alabama and at the Teesside airport Freeport. The proposed ML-70 was designed to feature the Ace Aerospace Ace Deck cockpit – similar to aircraft currently being upgraded for Austria. It was described as "an evolved and renewed combat-proven H-60 helicopter" and was to incorporate new dynamic components along with the updated Garmin G5000 glass cockpit that served as the foundation of Ace Deck.

AceHawk claimed there would be "little UK value" if Sikorsky were to produce new build Black Hawks at its factory in Mielec, and that a new S.70i would come with a premium price, as well as a "lengthy waiting list due to demand". The company said "choosing another route would jeopardise the capability, timeline, value-for-money, sustainability and social requirements of the NMH programme".

AceHawk planned to upgrade most of the pre-owned Black Hawks at Teesside International Airport to ML-70 standard, helping to meet the government's levelling-up agenda by generating jobs in an area of relatively high unemployment.

With Bell, Boeing and AceHawk eliminated, Airbus Helicopters, Leonardo Helicopters and Sikorsky were notified that they had been cleared for the next stage of the NMH bid process in the autumn of 2022. This was the release of the so-called invitation to negotiate (ITN). The ITN detailed the defence ministry's exact requirements for the NMH acquisition, though its release was subsequently 'pushed to the right'. The ITN was initially scheduled for September 2022, but that was delayed to the first quarter of 2023, then to later in the first half of the year, before being delayed again until late 2023. The publication of the ITN slipped further, and the ITN was finally issued in February 2024, with James Cartlidge, who was then the minister for defence procurement, announcing it at the International Military Helicopter conference in London.

In the meantime, concerns had been growing regarding the speed and status of the NMH programme. In May 2023, Dave Doogan, the Scottish National Party MP for Angus and a member of the House of Commons Defence Committee, declared: "NMH seems to be afflicted by a habit that defence procurement in the

United Kingdom finds difficult to break – keeping industry in the dark and then expecting them to deliver overnight, as well as kicking the can down the road and inviting what is loosely termed a capability gap, which poses a profound capability risk to the operation of our armed forces."

The MOD continued to keep quiet about the expected date of a contract award and refused to provide an estimate of when the new helicopter might achieve an initial operating capability.

Then, in July 2023, Lenny Brown, CEO of Airbus Helicopters UK, was quoted as saying that the industry had been informed that the requirement had been reduced and capped at 35 aircraft.

In November 2023, the MOD announced plans to purchase six Airbus Helicopters H145 Jupiter HC.Mk 2s for operations in Brunei and Cyprus. The Bell 212s and 412s previously in use would be retired and temporarily replaced by Pumas, which would yield to the H145s. The replacement of the Bell 212/412 aircraft had originally been part of the NMH requirement, leading many to assume this would result in a further reduction in NMH numbers. The minister, James Cartlidge, refuted this, stating that the number of helicopters to be procured under the NMH requirement to replace the Puma HC.Mk 2 and three other UK military rotorcraft types would remain unchanged. At the same time, the MOD reiterated that there had been "no change to the scope of the advertised New Medium Helicopter Contract Notice and Defence remains committed to this programme".

The MOD issued its ITN to the three remaining NMH bidders on February 27, 2024, thereby initiating the next stage of the New Medium Helicopter competition.

In June last year, it was reported that the assigned budget for the NMH had been reduced to £950m (including VAT) from the original tender value of £1.2m (excluding VAT), including training, spares and an initial five-year period of in-service support. The requirement had also been reduced to a minimum of 23 helicopters, with extra scoring for each extra helicopter up to a total of 33 aircraft. This minimum number was directly equivalent to the existing Puma fleet size.

In July, in response to a question from Labour MP Luke Akehurst (North Durham), new procurement minister Maria Eagle said tender 'returns' from the ITN were expected on August 30, 2024.

By then, there were unconfirmed reports that Lockheed Martin had abandoned the NMH competition or was on the verge of 'no-bidding'. This was denied, but industry sources suggested that Lockheed had been warned not to announce its withdrawal from the competition. Soon afterwards, there were rumours that Airbus was also preparing to 'no-bid', having reportedly informed the MOD that the programme was "not achievable" within the planned total contract value.

Sure enough, on August 30, it became clear that Leonardo Helicopters was now the only bidder in the race to supply a replacement for the RAF's Puma fleet.

Leonardo said it had met all the tender requirements and urged the MOD to accelerate the programme to save time and costs. It said it could deliver an aircraft within 12-14 months of the contract award. The company insisted that as much as 70 per cent of the value of the RAF AW149 would come from the UK, and the programme could potentially be worth billions in exports.

The capability gap predicted by Scottish National Party MP Dave Doogan in May 2023 became a reality in November last year when the government announced a package of defence cuts ahead of the planned strategic defence security review. These cuts included retiring 14 of the RAF's oldest Chinook helicopters and the 17 remaining in-service Puma helicopters. Many had hoped or expected that these would be 'run on' until the AW149 was in service, but the government confirmed the Puma would be retired when its support contract with Airbus Helicopters ended in March 2025.

➔

CLOCKWISE FROM ABOVE:

Approximately 100 AW149s have been ordered to date: 34 for Egypt, six for Thailand (army and police), 32 for Poland, four for North Macedonia and 24 for Malaysia. Deliveries to Poland began in 2023 and included this Italian-built example, although about 20 will be locally assembled in Świdnik
Polish MoD

Critics complain that the AW149 is a "green or black-painted oil and gas helicopter", while Leonardo asserts that the AW149 "began life as an all-new, blank sheet of paper, military design"

This aircraft, like those being delivered to Poland (and like the RAF's Pumas), lacks the extended radar nose seen on some examples of the AW149

The RAF's Puma fleet is due to be withdrawn from service on March 31, 2025, leaving a significant capability gap pending the introduction of the AW149
MOD/Crown Copyright

In response to MP James Cartlidge's question regarding the potential impact of these defence cuts on the NMH programme's progress, minister Eagle said on December 10 last year: "The decision to retire the 14 oldest Chinook helicopters and the remaining Puma helicopters has no impact on the New Medium Helicopter procurement process."

However, while the process may proceed as planned, the Pumas' retirement will leave capability gaps. The RAF is unlikely to have a medium-lift helicopter capability until late 2027, with a shorter gap in Cyprus and Brunei.

Eagle asserted that any capability gap in Cyprus and Brunei would be "fulfilled by another platform or mitigated by other means" prior to the introduction of the H145 in 2026. However, no information was provided about which platform would act as a stopgap, and no further details were given regarding what these "other means" might entail. As a result, there will be a gap of at least a year between the Puma's retirement and the incorporation of the H145 into the RAF fleets in Brunei and Cyprus.

John Healey, Labour Secretary of State for Defence, said that during this "short gap in capability" the MOD would implement "a commercial or military solution" for firefighting missions in Cyprus.

In response to a question from Conservative MP for South Suffolk James Cartlidge, regarding the government's plan to increase funding for the NMH programme, Eagle said on December 4 last year: "The Strategic Defence Review will guide future capability development priorities to ensure the United Kingdom remains secure at home and strong abroad – now and for years to come. The reviewers will present their final report in the first half of 2025, and it is therefore only right that we do not prejudice the details of the review at this stage… The NMH programme is part of a broader, holistic approach to the MOD's use of rotary-wing aircraft. The tender evaluation is currently ongoing and is expected to conclude with a contract award in the first half of 2025."

It became evident that the NMH timeline had slipped when Eagle responded to a written parliamentary question from Adam Dance, the Liberal Democrat MP for Yeovil. She said: "The proposal will be evaluated through 2025, when, subject to government approvals, a contract award is anticipated." This suggested that the contract award had been pushed from the first half of 2025 to the end of the year.

She stated that the competition "remains commercially sensitive" and that no further details would be confirmed until the evaluation and approval process was complete. Later, she added: "The progress of the New Medium Helicopter

ROYAL AIR FORCE

programme is not dependent on achieving 2.5% GDP of expenditure on defence spending."

As this issue went to press, it was revealed that at least one part of the capability gap left by the retirement of the remaining Pumas at the end of March 2025 would be 'filled'.

At least two Jupiter HC.Mk 2s, documented as H145, have arrived at the Airbus Helicopters facility at Oxford's Kidlington airport for modification. A third example is expected to join them soon, but they will not be delivered before 2026.

Thus, the deployment of an unspecified number of Chinooks for an indeterminate period during the 2025 fire season will support Cyprus's firefighting role.

Negotiations between the MOD and Leonardo Helicopters, the only remaining bidder in the competition, were nearing completion by the end of February 2025. If the strategic review did not disrupt them, a contract for the AW149 could be awarded in the third quarter.

The NMH process is still being treated as a 'competition' in procurement terms despite the absence of other bidders. Leonardo's bid is being evaluated within a 'competition' framework since treating it as a sole-source procurement would entail the adoption of new and more onerous oversight, resulting in delay and duplicated effort.

FlightGlobal's Dominic Perry reported that an official, speaking under Chatham House rules at the Defence IQ International Military Helicopter 2025 conference on February 25, stated that the NMH competition was proceeding according to the latest schedule: "It is still in a delicate phase, but we are getting close now." Perry also noted that Leonardo Helicopters mentioned: "We are currently in negotiations with the MOD. Discussions are positive, and we are confident about the progress being made as we work through the process."

In the absence of official reports, the 'jungle drums' have been busy, and several reports about the progress of the NMH process have been made, none of which can be confirmed. However, in the past, these sources have proved accurate predictors of programme progress (for example, when Airbus Helicopters and Lockheed Martin failed to submit bids at the end of the ITN phase).

Some sources suggested that final negotiations may have finished and that Leonardo Helicopters will soon submit a best and final offer (BAFO).

The number of aircraft will depend on fit – there will be different numbers of aircraft depending on whether a full defensive aids system is fitted fleet-wide, with "an extra cab or two if only a proportion of the fleet is fully equipped".

Some sources have suggested that the number of aircraft has reduced to about 14-16 – well below official 'expectations'. This would mark a significant reduction from the original 44 aircraft total, and from the subsequent 35 aircraft 'cap', and from the June 2024 requirement for a minimum of 23 helicopters, with extra scoring for each extra helicopter up to a 'ceiling' of 33 aircraft. If this is the case, many expect there to be a legal challenge by at least one and possibly both of the other bidders, who dropped out because they had been unable to resolve the number of aircraft required with the budget available.

More worryingly, there have been suggestions that Leonardo has struggled to meet certain NMH key user requirements (KURs). The crew-served weapons stations failed to meet KUR standards, and the ability to rapidly reconfigure the cabin was also questioned. It has also been alleged that Leonardo has had difficulties mounting the Miysis DIRCM system on the AW149.

Thus, as NMH negotiations reach their conclusion, there are a number of question marks hanging over the programme.

However, the usefulness of a medium-lift helicopter was dramatically illustrated on March 2, when a pair of Pumas carried Ukrainian President Volodymyr Zelenskyy to meet the King at Sandringham. **AI**

Surveyor is Pipistrel's special mission platform and is trusted across the world by defence, surveillance, and civil authorities in multiple configurations

If market forecasts are to be believed, the global intelligence surveillance and reconnaissance (ISR) market was worth approximately $36bn in 2023 and is expected to be worth more than $52bn by 2032 – a healthy compound average growth rate (CAGR) of 3.9%.

According to Steve McKenna, Director of Europe, the Middle East and Africa (EMEA) Sales at Pipistrel, the demand for ISR solutions is being driven by the increasing need for versatile, cost-effective, and technologically advanced aircraft capable of handling a wide range of mission requirements. Key factors, he says, include the need for longer flight durations, higher altitudes, and enhanced data transfer capabilities.

Interest in ISR solutions comes from both the military and civilian sectors. The ability to deploy ISR aircraft quickly and sustain operations over extended periods is becoming increasingly important.

McKenna says the company is seeing demand for efficient, cost-effective, and technologically advanced solutions.

Eyes in the skies

Alex Preston talks with Steve McKenna, Director of EMEA Sales at Pipistrel, to learn about the company's commitment to providing versatile, high-performance special mission solutions for its customers' diverse needs

While there are regional differences in this demand, they are not related to the aircraft itself. "Instead, the differences primarily revolve around payload integration and the preference for specific flight solutions. Each region has its unique operational requirements and technological preferences, which Pipistrel addresses through customisable payload options and tailored flight solutions."

One solution is The Surveyor, Pipistrel's medium-altitude endurance surveillance platform. Its efficiency, modular design, and advanced capabilities allow for easy customisation for a wide range of missions beyond ISR, including military surveillance, border security, environmental monitoring, and disaster response.

The Surveyor was introduced over a decade ago to support demand for advanced, versatile, and efficient special mission platforms. In terms of Virus SW, McKenna observes: "The need for aircraft that can perform long-duration missions, operate at higher altitudes, and provide real-time data is more critical than ever. By basing the Surveyor on the Virus SW airframe, we leveraged a proven and highly reliable platform that is known for its exceptional performance and efficiency."

The best-selling Virus SW's inherent strengths in high-speed cruising, cross-country flying, surveillance missions, and versatility in various operational environments provide a solid foundation, says McKenna, with the Surveyor further enhancing this by offering

ABOVE:
With different payload configurations, Surveyor can be deployed as manned, UAV or optionally piloted

OPPOSITE:
Steve McKenna, Director of EMEA Sales, Pipistrel

extensive customisation options to meet precise customer requirements. It's this exceptional versatility and advanced capabilities that makes the Pipistrel Surveyor stand out in the competitive ISR marketplace and why over 200 Surveyors are flying in different parts of the world.

One of its key advantages is its customisable platform, which allows it to be configured as a manned surveillance aircraft, a pure unmanned aerial vehicle (UAV) baseline platform, or an optionally piloted vehicle (OPV), but the customer decision must be made early in the order process, as it heavily influences the design of the platform and its features. In addition to performance and technical metrics such as preferred range, desired cruise speed, desired top speed, preferred endurance and at what speed, desired ceiling and planned highest landing altitude, possible features include the preferred placement of the sensors, weights, sizes and required energy consumption, any requested structural modifications and supports (SAR multiband sensors, GSM and satellite tracking systems, lidars and magnetometers), cockpit avionics requirements and special avionics requests such as weather radar, lighting radar, long-wave radio, what redundancy is requested etc.)

Both configurations are designed to be intuitive and user-friendly, ensuring seamless operation in a variety of missions and environments. The fly-by-wire system, developed by Textron Aviation GmbH, further enhances the handling experience by providing precise and reliable control.

The OPV configuration features a robust cockpit equipped with advanced avionics from Dynon, which integrates full physical

controls with a touchscreen. The angled control panel of the SkyView HDX allows for direct human control using a natural hand position, thereby reducing fatigue. The wide, sculpted ledge enables the pilot to anchor their hand for precise control during turbulence. The single-screen multifunction engine and flight instrument includes all flight and engine instrument functions, such as the engine monitoring system (EMS), outside air temperature (OAT), flight plan (FP), and moving map (MAP).

The cockpit can be configured as a single pilot and operator crew with one set of flight controls or a twin crew with two sets of flight controls, making it ideal for missions requiring immediate intervention or training.

The UAV configuration, on the other hand, is fully autonomous, featuring sophisticated autopilot systems and mission management software, making it ideal for long-duration surveillance and reconnaissance. For instance, after years of secrecy, it was confirmed in mid-2020 that the Surveyor had been conducting operations on behalf of the US Special Operations Command (SOCOM). It was equipped with sensors to collect full-motion video and signals intelligence during long-endurance surveillance missions lasting up to 30 hours and reaching altitudes of 30,000ft.

Surveyor's special mission solutions include three distinct platforms – low (up to 12,00ft), medium (up to 18,000ft) and high-altitude (18,000-30,000ft) capabilities. These variants offer a range of capabilities and options.

There are two low altitude models: the Low Altitude, Short Endurance (LASE) and Low Altitude, Medium Endurance (LAME). With a Rotax 912 A2, 80 Hp 2 Carb, V3 engine gearbox and governor, both typically operate between 2,000-12,000ft and have a maximum take-off weight of 600kg and a maximum zero fuel weight (MZFW) of 530kg. LASE has a wingspan of 12.4m, shorter than LAME which has a 15m wingspan, but it boasts a removable wingtip which helps reduce the hangaring wingspan to 12.15m to fit in a classic American-size T hangar. LASE has a maximum loitering speed of 90kts compared to LAME's 75, making them replacements for helicopters for observing targets at a very low orbiting speed, and an endurance of up to six hours (LAME has eight hours). LASE can fly in wind gusts up to 90kts, while LAME can endure 86kts.

In the medium altitude category, The MASE (Medium Altitude, Short Endurance) version is powered by a Rotax 912 S3, 100 Hp, 2 Carb, V3 engine gearbox and governor, allowing it to reach a maximum altitude of

CLOCKWISE FROM ABOVE:
The Surveyor's UAV cargo compartment allows for the transport of supplies for remote areas or in times of disaster response

The Surveyor has a fuselage mount for camera or wing pod mount for advanced sensor pack, making it an ideal choice for ISR missions

The high cantilever wing makes the platforms ideal for surveillance

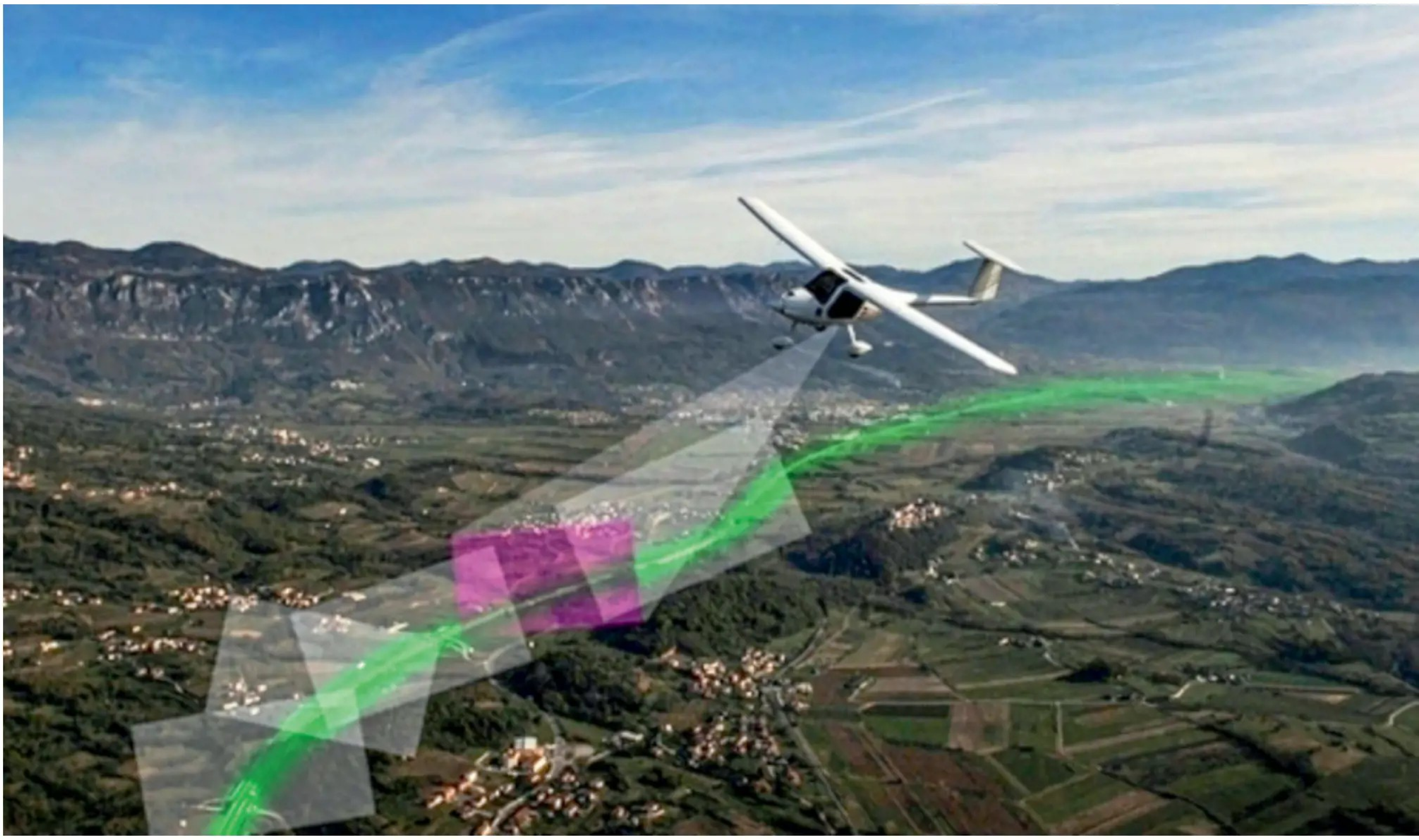
18,000ft although its typical operating range is between 2,000-12,000ft. Both MASE and MAME – Medium Altitude, Medium Endurance) have a wingspan of 10.7m, a maximum loitering speed of 90kts, and can tolerate winds up to 120kts. MASE has an endurance of eight hours compared to the 24 hours plus of MAME, making it ideal for longer endurance missions.

Although MAME and MALE (Medium Altitude, Long Endurance) share the same Rotax 912 iSc, 100 Hp, fuel injection, V3 engine gearbox and governor, MALE has a 15m wingspan with removable wingtips and a higher typical operating ceiling of 15,000ft. It has a maximum loitering speed of 75kts and can tolerate winds up to 120kts. MASE has an endurance of 33 hours

HALE (High Altitude, Long Endurance) has a 15m wingspan with removable wingtips. Its Rotax 914, 115hp, turbocharged engine with intercooler for extreme altitude allows it to reach a maximum altitude of 30,000ft. However, it typically operates at between 10,000-22,000ft, allowing it to climb higher than competitors to avoid aircraft spotting from ground observers or to cross mountains. HALE can sustain a maximum loitering speed of 75kts for up to 25 hours and tolerate winds up to 87kts.

This flexibility means it can adapt to a wide range of mission requirements. Additionally, McKenna explains that the Surveyor is a low-cost aircraft, and its design allows for easy disassembly and shipment, making it highly mobile and accessible for rapid deployment. "The Surveyor is also known for its quiet operation, which is crucial for stealth missions. These features, combined with its reliability and ease of operation, make the Pipistrel Surveyor a standout choice for various missions, including aerial survey, environmental monitoring, surveillance, reconnaissance, and disaster response," he states.

The Surveyor is designed to operate effectively in a wide range of environments to satisfy these missions.



In conversation with *Air International*, McKenna gives further details of the aerodynamic design, which is optimised for efficiency and stability across various altitudes and weather conditions (wide temperature operating envelope (-40°C to + 55°C), ensuring consistent performance, whether it is operating at low altitudes for detailed surveillance or at higher altitudes for broader coverage.

"We use high-quality, durable materials, such as advanced composites, that are resistant to corrosion, fatigue, and extreme temperatures, maintaining their structural integrity and performance characteristics in both hot and cold climates. All critical components, including electronics and sensors, are sealed to protect against moisture, dust, and other environmental contaminants, ensuring reliable operation in humid, dusty, or salty environments."

The Surveyor can take-off and land on very short (230m) runways, as well as unprepared runways. It is also available for operation from rough runways using Tundra wheels (available only for tail wheel configuration offered by HALE).

"The Surveyor is also equipped with advanced thermal management systems to maintain optimal operating temperatures for all onboard systems, which is crucial for consistent performance in both hot and cold conditions. Additionally, the modular design allows for easy customisation and maintenance, providing flexibility to quickly adapt to different mission requirements and environmental conditions.

"Each Surveyor undergoes rigorous testing in simulated and real-world environments, including extreme temperatures, high humidity, and high-altitude conditions, to validate its capabilities and ensure it meets our high standards for performance and reliability," McKenna says.

Surveyor can be further customised to adapt to customer requirements. This includes modifications to payload capacity, sensor integration, communication systems, and endurance capabilities. "We offer this service to provide our customers with the flexibility and tailored solutions they need to succeed in their missions," says McKenna.

Whether it's a standard model or a customised option, McKenna stresses that Pipistrel prioritises equipping the Surveyor with the most advanced and mission-appropriate avionics and satellite communications solutions.

"Our focus is on ensuring that each aircraft is tailored to support the specific requirements of the mission set, whether it involves high-precision data collection, long-range communication, or real-time surveillance. We work closely with our customers to integrate the best available technologies that enhance the Surveyor's performance and reliability. This approach ensures that our customers have the right equipment to achieve their objectives, no matter the operational environment."

For instance, in 2021, Honeywell introduced its Small UAV SATCOM system to the Surveyor, the first time it was implemented specifically on an unmanned cargo or optionally manned aerial vehicle.

At only 1kg (2.2lb), the Small UAV SATCOM system is 90% lighter than the company's next smallest connectivity system.

Speaking at the time of the announcement, Pipistrel CEO Ivo Boscarol stated that the company was "excited to offer our customers a global communication solution, which is location-independent and cost-effective." He added: "The addition of Honeywell's Small UAV SATCOM to our unmanned aircraft platforms unlocks global beyond-visual-line-of-sight (BVLOS) connectivity for command and control, as well as mission-specific data relay. Our customers will enjoy the ability to connect to their assets anytime, anywhere, without the need to establish elaborate ground-based BVLOS infrastructure."

Other technologies include advanced video systems designed to meet the demands of various surveillance and reconnaissance missions. The Surveyor's video platform includes Electro-Optical/Infrared (EO/IR) sensors, which provide high-resolution video surveillance and video recording through a 28x digital

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UAV Pipistrel Surveyor aircraft have been operated by the US Special Operations Command (SOCOM) and acquired as part of the Long Endurance Aircraft Program

zoom for day surveillance and 640 x 480 infrared thermal imaging camera for night operations, and full-motion video (FMV) systems, which capture continuous video footage for real-time monitoring and intelligence gathering for defence, border patrol and law enforcement missions. The 1TB solid-state HD for long-endurance video recording is specifically designed for high operating altitudes.

Additionally, some configurations feature Light Detection and Ranging (LIDAR) systems, supported by a high-resolution (36 MP) photographic camera mounted on a gyro-stabilised gimbal. The video system integrates seamlessly into the aircraft, enabling long-endurance missions that can last up to 30 hours. It is ideal for aerial survey tasks, including post-natural disaster damage assessments.

Another video configuration is Surveyor LDC, a look–down camera for cartography using an automated image tracking and alignment gimble. The LDC system consists of an onboard navigation computer, camera gimble, and software for aerial surveys. Supported features include automatic camera triggering above pre-planned spots, screen confirmation of exposed pictures, GNSS [global navigation satellite system], and electronic compensation of the camera direction for wind (crab angle).

The UAV cargo compartment also allows transporting supplies and equipment, particularly in remote or hard-to-reach areas. In disaster response scenarios, the Surveyor can be deployed for assessment and relief operations, providing real-time data and imagery to aid in decision making.

In April 2022, Pipistrel was acquired by Textron and became part of Textron's newest business segment, Textron eAviation. This segment aims to pursue Textron's long-term strategy of offering a family of sustainable aircraft for urban air mobility, general aviation, cargo, and special mission roles. Under the terms of the transaction, Textron purchased Pipistrel for a cash price of approximately €218m, with Pipistrel's headquarters, research and development, and manufacturing remaining in Slovenia and Italy. Textron plans to make additional investments to expand manufacturing and product development capabilities.

As McKenna reveals: "Our ambition is to continue developing advanced special mission solutions that meet the evolving needs of our customers, whether they require longer flight durations, higher altitudes, or enhanced data transfer capabilities. Being part of the Textron family significantly enhances our ability to achieve these goals. Textron Inc. and Textron eAviation's resources, global reach, and deep expertise in aerospace and defence provide us with the support and capabilities needed to push the boundaries of what is possible."

In May 2024, Textron further expanded its portfolio by acquiring Amazilia Aerospace GmbH, a developer of digital flight control, flight guidance, and vehicle management systems for civil manned and unmanned aircraft. The former Amazilia Aerospace team will collaborate closely with Textron eAviation's Pipistrel team on aircraft such as the Surveyor.

"We will continue to build our experience with emerging technologies, ensuring that we stay at the forefront of innovation in the aviation industry," says McKenna. "Our focus remains on interweaving the voice of our customers into every step of the development process. This customer-centric approach allows us to bring to market differentiated products that not only meet but anticipate the evolving needs of our customers and the industry." **AI**

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Eight Questions

Cutting-edge developments allow the RAF's recycling programme to convert old fourth-generation Tornado aircraft parts into powdered metal, which is then used to 3D print components for the sixth-generation Tempest. Those heavily involved in the programme spoke with *Air International*

Question 1: **Can you explain the background and reason for developing the Tornado 2 Tempest project? Aside from the potential cost savings, what are the goals of such a process?**
Funded by the UK Ministry of Defence (MOD) UK Strategic Command Defence Support, Tornado 2 Tempest is a collaborative project led by Defence Equipment and Support's Defence Recycling & Disposals Team (DRDT) and involving the MOD Future Combat Air System (FCAS) team, Additive Manufacturing Solutions (AMS) and Rolls-Royce.

The Tornado 2 Tempest project was developed to address the increasing challenge of securing critical raw materials for the defence and aerospace industries and to assess the recyclability of Defence's historic assets. With global supply chains facing mounting pressures, the MOD recognised the need to rethink how strategic materials are sourced, used and potentially re-used. Rather than relying solely on virgin raw materials to manufacture new Defence capabilities, this initiative explored how high-performance metals from retired aircraft could be repurposed to meet current and future demand.

To demonstrate the value of implementing a circular economy for strategic metals, DRDT contracted AMS to take jet engine compressor blades from a low-pressure air compressor, atomise them into metal powder, and use that powder as additive manufacturing feedstock to 3D print a nosecone for the Rolls-Royce Orpheus engine, which is being developed as part of FCAS. Subsequently, this nosecone was installed and run as part of an engine test to evidence the safety and effectiveness of metallic 3D-printed components.

In addition, Rolls-Royce created a Digital Product Passport (DPP) for the nosecone. The digital ledger allowed Rolls-Royce to record the asset's material data, including its composition, recycled content, and embedded carbon, to create a lasting, accurate and updatable digital account of this particular component's manufacturing and service history.

At its core, Tornado 2 Tempest is about innovation. It demonstrates how new technologies, such as additive manufacturing, can breathe new life into materials that would otherwise be discarded. Such projects could enhance the UK's supply chain resilience and ensure the UK Defence sector's access to the strategic materials it needs despite uncertain global supply challenges.

Question 2: **What parts from the Tornado fleet are suitable for this process? Can you talk us through the method, from the initial removal of the part from the Tornado airframe to the new Tempest component? How long does the process take compared to new parts?**
AMS's method emphasises understanding the chemistry of materials. AMS measures, screens, and selects parts that fulfil the chemical requirements of the end-use material, which, in the case of Tornado 2 Tempest, is titanium. Next, the geometry of potential donor components – from blades to bolts and everything in between – is evaluated, with the optimal asset selected and atomised into powder. For Tornado 2 Tempest, the Tornado fan blades were chosen, but many other used and unused aircraft components could also be recycled in this way.

A rendering by Rolls-Royce of Orpheus – the company's small engine concept for the MOD's Future Combat Air System (FCAS)

All images via Rolls-Royce

AMS
Additive Manufacturing Solutions Ltd.

CLOCKWISE FROM TOP ABOVE:
Andrew Eady, VP of Sustainability, oversees sustainability for Rolls-Royce Defence in the FCAS and the Global Combat Air Programme (GCAP)

Robert Higham, AMS Director

Thomas Powell, Senior Commercial Manager for Strategic and Submarine Recycling at DRDT, is responsible for leading sustainability and circular economy projects in the UK MOD's Defence Equipment & Support, Defence Recycling & Disposals Team

A nose cone for the Orpheus engine, made from recycled and 3D-printed materials

A cutaway illustration of the Orpheus concept power plant

Once the powder is created, it can be used in any laser powder bed fusion machine, which melts the powder and prints many thin layers – approximately half the width of a human hair per layer – until the final geometry is achieved. Time is then spent checking, inspecting, and preparing the part for final delivery. It can take as little as two to three days, from sourcing materials to creating a new part. In comparison, securing the necessary materials, shipping them to the UK, and machining would take weeks or months, generating significant carbon emissions and waste compared to 3D printing.

Question 3: **Can you outline the importance of Government, industry, and SME collaboration?**
Collaboration between government, industry partners, and SMEs is essential to driving innovation in aerospace. Tornado 2 Tempest is a prime example of how such a partnership can lead to advancements.

The MOD outlines its requirements and provides strategic oversight, ensuring that research aligns with national defence priorities. Industry partners like Rolls-Royce contribute engineering expertise and the capacity to scale new technologies. Meanwhile, SMEs, like AMS, offer agility and innovative thinking, often pioneering new techniques that can be swiftly tested and refined.

This collaborative approach accelerates technological progress and promotes cost efficiency, knowledge sharing, and spillovers that can benefit sectors beyond defence. By working together, various industries can address challenges, such as integrating circular economy principles. The success of Tornado 2 Tempest demonstrates that when expertise is shared across different organisations, the result is a stronger, more sustainable future for defence and the broader aerospace engineering field.

Question 4: **Can you explain nose cone testing with regard to the Orpheus test engine and how this relates to the Future Combat Air System (FCAS)?**
Orpheus is a novel, small-engine family concept that is being developed as part of the FCAS. It can be rapidly scaled and easily configured – and is ready for use in multiple applications. Importantly, the Orpheus demonstrator has given Rolls-Royce the capability to pull through new technologies by demonstrating them on a representative system, in an affordable and timely manner, which supports Rolls-Royce's business and industry goals.

As part of Tornado 2 Tempest, we did just this: we installed the 3D-printed nose cone onto the Orpheus test engine and completed a series of evaluations to assess its performance and sustainability, with positive results.

Question 5: **Can you explain more about the Digital Product Passports (DPP) and how this process will help with informed decision-making?**
DPPs are crucial to the Tornado 2 Tempest project. They offer a secure and transparent method for tracking materials throughout their lifecycle. Using a digital ledger, the DPP records vital information about a component, including its composition, recycled content, embedded carbon, and usage history.

This level of traceability is a game-changer for aerospace and defence. It allows engineers and decision-makers

to make informed choices about how materials are used and repurposed, ensuring valuable resources are not wasted. It also helps to improve supply chain resilience by identifying counterfeit materials and tracking the performance of components over time. By potentially embedding DPP technology into other areas of defence manufacturing and projects, Rolls-Royce continues to embrace a smarter, data-driven approach to material management, ultimately improving efficiency and sustainability.

***Question 6:* Why are discovery projects like Tornado 2 Tempest important as part of the long-term FCAS programme?**

Discovery projects like Tornado 2 Tempest play a crucial role in shaping the future of combat air technology. This work provides an opportunity to test and validate new manufacturing techniques before they are integrated into large-scale programmes. By experimenting with circular economy principles, additive manufacturing, and digital tracking systems, this project has helped mitigate the risks associated with introducing such innovations.

The insights gained from Tornado 2 Tempest will ensure that future programmes benefit from the latest advancements in material science and sustainable engineering. In the long run, this approach could enhance supply chain resilience, reduce operational costs, and ensure that future air combat platforms are built with sustainability in mind.

***Question 7:* What other areas is the DRDT looking into? Could these processes be applied to other platforms, such as unmanned platforms or commercial aircraft?**

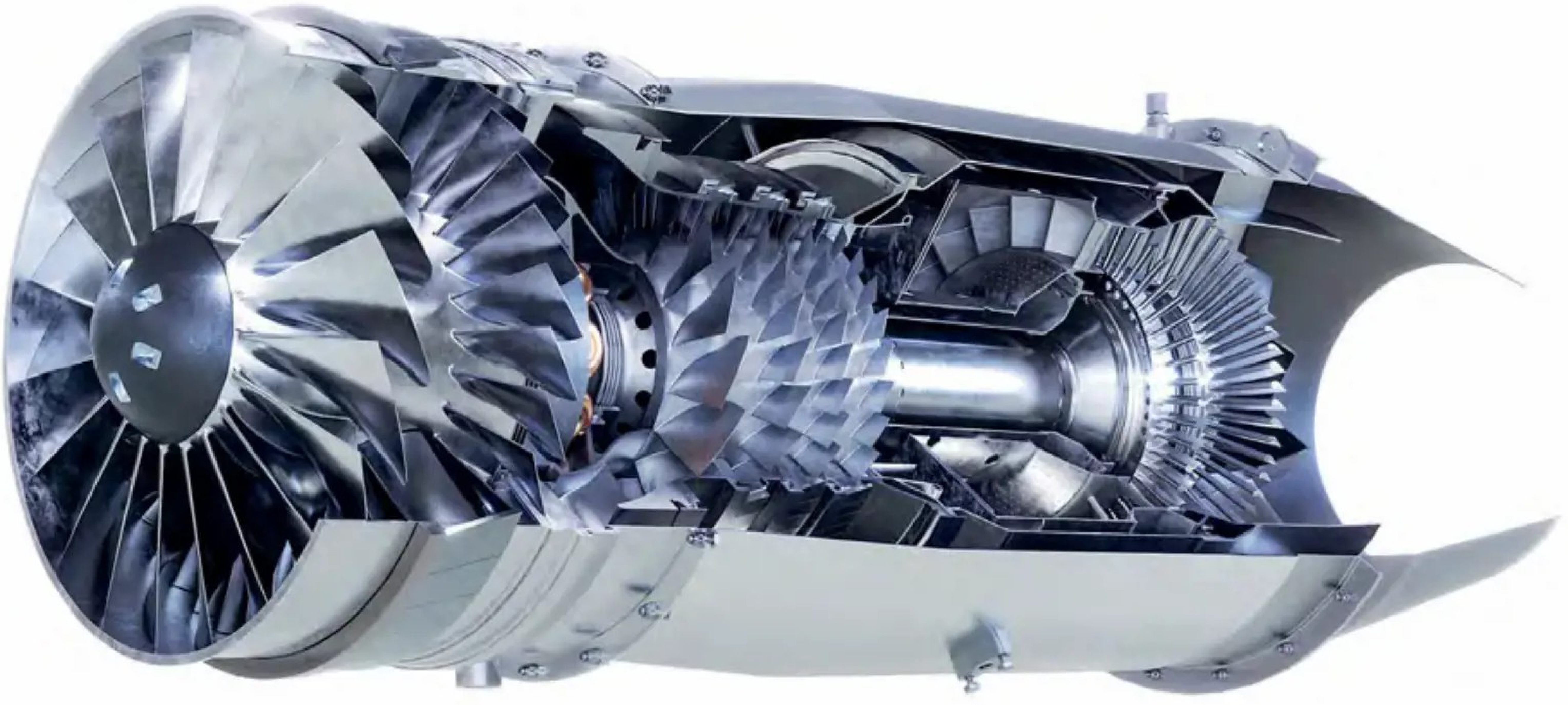
DRDT is responsible for the compliant recycling and disposal of various MOD assets, both large and small, while delivering optimised solutions in collaboration with our contractors and partners, including AMS and The Royal Mint. Meanwhile, commercial recycling technologies continue to evolve, enhancing their effectiveness and efficiency. Broader geopolitical considerations may also increase the risks to UK defence supply chains. Consequently, there are numerous opportunities for DRDT and the wider defence sector to engage with UK industry and SMEs to assess the suitability of these emerging solutions for recycling MOD assets in the UK, aiming to retain recovered strategic and precious materials within UK defence and industry. The outcomes of DRDT's innovation, sustainability, and circular economy projects, such as Tornado 2 Tempest, are expected to unlock additional benefits and use cases for defence, including applications on unmanned platforms while potentially revealing opportunities for broader industry use, such as in commercial aircraft. Therefore, DRDT will continue to publish communications and updates through our official channels, as these projects provide knowledge, experience, and results that can greatly benefit both defence and the wider UK industry.

***8 Question:* On a personal level, how do you spend your free time? Any hobbies that you enjoy?**

Robert Highman, AMS: Spare time? What's that?! When I'm not discussing metals and additive manufacturing at work, I talk about it with my kids and even the dog if he will listen. I'm an enthusiastic BBQ fan, and some of my additive manufacturing peers seem to have caught the bug, so a small group exclusively talks about 3D-printed BBQ utensils.

Thomas Powell, DRDT: I feel fortunate to have hobbies; however, most of my free time is devoted to my family. Reflecting on my hobbies, I find myself lacking time while also considering which defence asset to recycle next. As a proud Welshman, I seize every opportunity to explore my homeland, traverse its hills, and appreciate its history – all while utilising my Cardiff University-trained Ancient History skills to research and document our family's history, with a slight natural bias toward the extensive military and defence-related aspects.

Andrew Eady: We've just welcomed a baby boy named James. **AI**



MAY ISSUE **ON SALE APRIL 24**

Single-pilot commercial flights may be an option in the future for aircraft types like the A350 Airbus

The ATR 72-600 is the latest model in a long line of turboprops that have supported the commuter and regional sectors for many years, ensuring profitability for ATR ATR

Next Month

Single-pilot solution?

Is the single-pilot operation of airliners likely to become a reality in the next decade?

Propelling forward

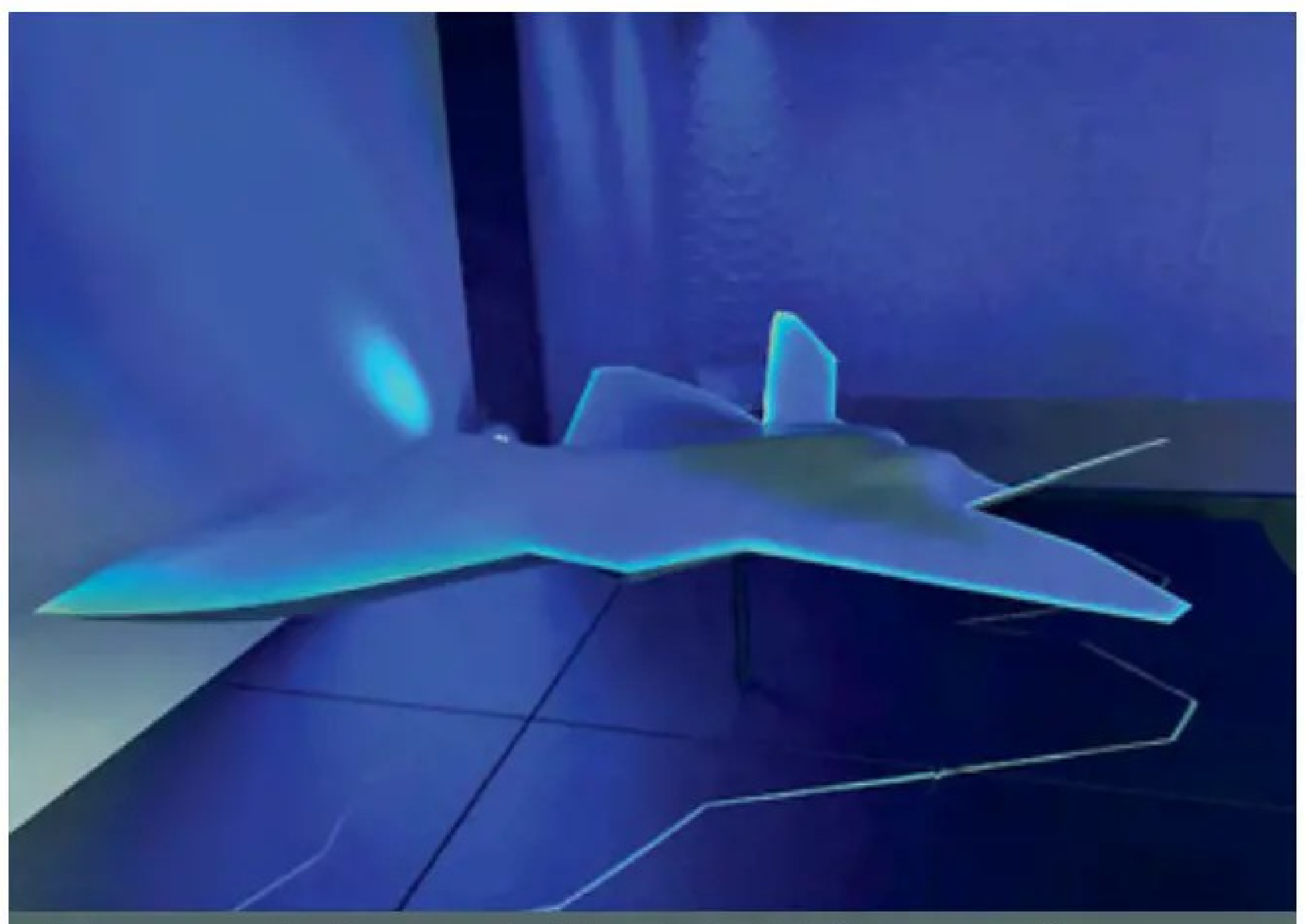
Forty years ago, ATR was in the final stages of certifying its first aircraft, the ATR 42. Now, as a leading manufacturer of commercial turboprop airliners, the company is preparing to address the challenges of meeting customer demand.

Is Concept Class Five an option?

With the apparent loosening of America's commitment to its European allies, some believe there is a genuine need for a second manned platform within the FCAS system.

Kings of Korea

Korean Air has completed the £1bn acquisition of Asiana and is now one of Asia's largest airlines.


The current changes in the global defence sector are paving the way for new and revised FCAS concepts. Both manned and unmanned options represent just one solution BAE Systems

New acquisitions and new aircraft: Korean Air has expansion plans and the capability to pursue these ideas Korean Air

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